HEALTH MAINTENANCE IN INDUSTRY

611095

BY

J. D. HACKETT

CONSULTANT ON LABOR RELATIONS,
LECTURER ON LABOR AND EMPLOYMENT MANAGEMENT,
NEW YORK UNIVERSITY;
FORMERLY MANAGER, MEDICAL DEPARTMENT,
NICHOLS COPPER COMPANY

STATE CENTRAL LIBRARY W.B. * P Road, Kolkata

CHICAGO & NEW YORK
A. W. SHAW COMPANY
LONDON, A. W. SHAW AND COMPANY, LIMITED
1921

PREFACE

CHICKENS, race-horses, and circus monkeys are fed, housed, trained, and kept up to the highest physical pitch in order to secure a full return from them as producers in their respective functions. The same principle applies to human beings; increased production cannot be expected from workers unless some attention is paid to their physical environment and needs.

The object of this book is to show those who manage plants, and are, therefore, responsible for the management of medical departments, how the worker's health may be maintained and improved as a means of increasing production. The subject is treated simply and its medical and surgical aspects are dealt with only in so far as may be necessary to their understanding from the plant manager's point of view. He should know what is taking place and why it is taking place.

Whether a medical department, through which health improvement is accomplished, is immediately or ultimately under the plant manager's control, he will find a general knowledge of the whole subject highly advisable. He should be able to direct the health maintenance activities of a plant understandingly but without any attempt to interfere with purely medical questions which are the responsibility of the doctor.

Plant medical departments work badly when they lack the intelligent cooperation of those who are responsible for, yet ignorant of, the details of their operation. The plant manager must know what, as well as what not, to do to make the medical department an efficient aid to production; in a word, he must be able to guide and direct the medical staff just as he guides other technical branches of plant operation.

There is a wide-spread and chronic loss in output due to sickness about which little is known in managerial circles, and the subject is often ignored in order to avoid the assumption of yet another burden. But production must be increased, and, moreover, although the worker may appear to carry the entire loss due to sickness, it eventually lies on the employer at an increased ratio.

There is a slight but well-marked trend on the part of employers to assume medical costs and shift them from the worker who can ill afford them to the product where they logically belong. It would be quite unjust, however, to saddle the employer with responsibility for all sickness occurring in industry; but, whether he likes it or not, he is largely the victim and the way out is to adopt the best measures possible for health conservation in industry.

Responsibility for the worker's health has been freely accepted in some instances and there is not a case on record where it has been regretted. Moreover, an employer can supply the best medical service to his employees at a fifth of the price they would have to pay as individuals. But the governing factor is that the plant, as a medical unit, holds out great possibilities in the improvement of industrial health.

Judge Elbert Gary, chairman of the board of directors of the United States Steel Corporation, says that his organization has spent over $100,000,000 alone on welfare work in the last 10 years and that, "It pays in dollars and cents, as a net result in profits, during the year to make the most liberal expenditures in protecting the lives and persons of employees."

The Census of Manufactures shows that there were 8,763,233 wage-earners in industry in 1923. On an individual basis, the cost of materials, including fuel, mill supplies, containers, and so forth, amounted to $3,951.50, the value added by manufacture was $2,950.16, the total value of the product was $6,901.69 and the average wage was $1,253.65 in that year. Health maintenance of the wage-earner is, therefore, an investment in protection.

The author acknowledges with gratitude the help he has received from Mr. John B. Andrews, Mr. John Muller, Dr. W. J. M. A. Maloney, and Mr. W. Dean Keefer, who are specialists in their respective fields, and also from a multitude of other sources which it would be impossible to mention individually in so brief a book.

J. D. HACKETT

CONTENTS

PREFACE iii

PART I. HEALTH MAINTENANCE

I

INDUSTRIAL HYGIENE 3

Health, a great industrial asset. What is industrial hygiene? Its importance in increasing output. Improvement of machines or human beings. High sickness and death-rate among workers. The purpose of medical service. Relation to state health insurance. Unrest and sickness. The worker and his health. Sick benefits or prevention? Labor's Health Policy.

II

INDUSTRIAL MORTALITY AND MORBIDITY 15

A. Mortality among wage-earners. High death-rates in industry. Age and death-rates. Sex and death-rates. Hazardous occupations. Causes of death among workers. General death-rates and tuberculosis among males and females compared. Longevity in various occupations. Indoor and outdoor occupations. B. Morbidity. Sickness in the community. Community surveys. Army rejections. Defects found. Sickness in industry. Physical impairments. Absence and sickness. Accidents and sickness compared. Causes of sickness. General hazards. Industrial hazards. Cost of sickness. Responsibility. Health laws.

III

MEDICAL SERVICE IN INDUSTRY 41

Origin of medical service. Its extent. A sign of progressiveness. Preventability of sickness. Justification for medical work. Reduced sickness and prolonged lives. Cost of absence, and lowered production. Is medical service necessary? Its scope and aim. Medicine, surgery, hygiene, and sanitation. Family medical service.

IV

ORGANIZATION OF MEDICAL SERVICE 52

Its place in the plant. Investigating the need. Determining functions. Getting the work done. Placing responsibility. Coordination with production and employment departments. Size and type of medical department. Whole-time, part-time, or cooperative service. The woman doctor.

V

THE MEDICAL STAFF 62

Its character. The plant physician. His selection and qualifications. Conditions of employment and salary. Tests of efficiency. The nurse. Industrial or visiting. Qualifications and duties. Medical assistant. Relationships, in plant and outside.

VI

THE EMERGENCY HOSPITAL 80

Character and functions. Nomenclature. Determining its size and location. Construction and plans. Waiting-room. First-aid room. Operating and ward-room. Service rooms. Equipment. Furniture, instruments, medical and surgical supplies. Medical forms and records. Typical plant hospitals. Extent of usage.

PART II. THE MEDICAL DEPARTMENT

VII

MEDICAL SERVICE 103

Medical first-aid. Increase in popularity. Equipment and layout of dispensary. Bottles and shelves. Dispensing medicine in the plant. Medical duties; prevention and cure. Preventive methods. Health education. Publicity methods. Health literature. "Health Hints."

VIII

MENTAL HYGIENE 116

A need in selection. Attitude and production. Extent of abnormality in industry. The menace to harmony. Mental hygiene and mental defects. Types of abnormal workers. The subnormal; the psychoneurotic; the psychopath. Functions of the psychiatrist.

IX

MEDICAL TREATMENT 127

Basis of sickness experience. Promptness a necessity. The minor ailments, their ascertainment and treatment. The common cold and its extent. Epidemics and their prevention. Other minor ailments. Heart disease and its prevalence. Tuberculosis. Venereal diseases.

X

OCCUPATIONAL DISEASES 150

Extent of occupational diseases. Their classification. Relation to workmen's compensation. Causes. Prevention. Protection. Lead poisoning; its extent, properties, and prevention. Mercury. Multiple poisons. Carbon monoxid. Nitrous oxide. Benzol. Artificial respiration. Arsenic. Recommendations to employer.

XI

OCCUPATIONAL DUSTS 190

Their prevalence in industry. Classification; organic and inorganic dusts. Occupational exposure. Tuberculosis and dusty occupations. Death-rates. Prevention methods. Occupational skin diseases. Extent and prevention. Anthrax. Prevalence, treatment, and prevention.

XII

PHYSICAL EXAMINATION 206

Its object. Relation to health of workers. Physical impairments. Classification of disabilities. Advantages and disadvantages. Types of examination. Basis and methods. Examination form. Defects and rejections. Time, length, and place of examination. Special phases: hernia.

XIII

EYES AND TEETH 238

Eyesight and eye examinations. Extent of eye defects. Occupations subject to strain. Eye testing. Test cards. Estimate of loss of vision. Value of eyesight. Industrial dentistry. Its scope. Inspection. Examination, corrective, and restorative work. The organization of a dental department. Office and equipment. Cost.

PART III. THE SURGICAL DEPARTMENT

XIV

SURGICAL AND FIRST-AID TREATMENT 259

Sickness and accidents compared. Relative gravity of injuries. Surgical treatment. First-aid organization. First-aid room. Equipment. Standardization. Extent, cause, and prevention of infections. First-aid training. Medical and surgical costs.

XV

ACCIDENT PREVENTION 279

Extent; general and industrial. Causes of accident. The human element. Accidents and new employees. The location, extent, and nature of injuries. Prevention. Safety organization. Safeguarding. Education. Inspection. Records and reports. Frequency and severity. Results obtained.

XVI

WORKMEN'S COMPENSATION 312

Methods of insurance. Private insurance companies. Mutual insurance. State funds. Self-insurance. Waiting period. Compensation and occupational disease. Types of compensation laws. Rate of compensation. Cost of compensation. Prevention or compensation.

PART IV. PLANT HYGIENE

XVII

VENTILATION 323

Present conditions. Importance of ventilation. Elements in ventilation. Temperature. Humidity. Air movement. Purity. Causes of bad air. Nature of air constituents. Temperature in the shops. Comfort zone and temperature. Methods of ventilation; structural and mechanical. Ventilation and output. Ventilation and sickness.

XVIII

HEAT AND HEATING 350

Heat and production. Sources of heat. How to keep cool. Protection from heat and cold. Plant heating. Air, steam, and hot water contrasted. Regulation of plant heating. Cooling air in summer. Dangers of salamanders.

XIX

PLANT LIGHTING 358

Importance. State provisions. Causes of bad lighting. Sources of light; essentials of good lighting. Lighting code. Natural lighting. Relation to windows. Artificial lighting. Determination and measurement. Relation to production.

XX

FOOD AND LUNCH ROOMS 367

Food and output. Factors in providing lunch rooms. Determining the need. Methods: lunch room; cafeteria, buffet, lunch wagon. Extent of usage. Lunch room. Layout. Size and seating capacity. Attendance. Equipment. Management. The cafeteria system. Cost of supplying food. Method of payment. Advantages.

XXI

FATIGUE REMOVAL, REST PERIODS, AND SEATING 384

Loss due to industrial fatigue. Nature and effect of fatigue. Signs of fatigue. Factors in fatigue: extrinsic and intrinsic. Cause of fatigue. Hurry and monotony. Avoiding fatigue. Hours and wages. Posture. Rest periods. Rest-rooms. Seating.

PART V. PLANT SANITATION

XXII

TOILET FACILITIES AND SANITARY STANDARDS 415

Present conditions. Scope of plant sanitation. Ascertaining the sanitary needs. Functions, organization, and management of sanitation. The sanitary code. The "Sanitary Unit" sanitary standards. Toilet-room: water-closets and compartments; urinals.

XXIII

WASH-ROOMS AND WASHING FACILITIES 439

Extent in industry. Plant requirements. Equipment: wash-basins; wash-troughs; wash-fountains. Washing time. Towels and soap. Cost of towel supply. Showers. Types. Water for showers. Amount of usage. Swimming pools; indoor and outdoor.

XXIV

LOCKERS AND LOCKER-ROOM 453

The locker-room; location and equipment. Types of lockers: wooden or metal. Size, color, and material. Arrangement of lockers. Equipment: shelves, hooks, locks, and keys. Ventilation and heating of room. Inspection. Ceiling hooks. Methods of drying clothes.

XXV

LAUNDRY AND CLEANING 460

Growing use of plant laundries. Their location, equipment, and installation. Scope. Advantages. Plant cleaning and hygiene. State laws and cleaning. Organization of cleaning department. Supervision. Hand and mechanical cleaning. Cost of plant cleaning.

XXVI

DRINKING WATER AND BUBBLERS 465

Importance of water supply. Water testing and water purification. Methods of supplying drinking water. The pail and the bubbler. Apportionment of bubblers. Types: vertical or slanting. Refrigeration. Temperature.

XXVII

CONCLUSION 470

Health improvement practicable. An aid to production and a symbol of good-will. The plant as a health unit. Prevention versus cure. Plant medical work inexpensive. A part of the organization. Its present position. Medicine and surgery contrasted. Common ailments important; occupational diseases infrequent. Health maintenance, the remedy. State health insurance, the alternative.

INDEX 481

TABLES

1. Death-Rates per 1,000 Persons Exposed, Classified by Sex and by Age Period 16
2. Death-Rates in Some Typically Hazardous Occupations 17
3. Metropolitan Life Insurance Company Death-Rates per 100,000 for Principal Causes. Premium-paying Business in Industrial Department, 1914 to 1924... 18
4. Death-Rate from Tuberculosis, per Thousand, Male and Female Operatives and Non-Operatives 19
5. Longevity in Various Occupations 20
6. Number and Percentage of Deaths from All Causes among Machinists as Contrasted with Farm Laborers, by Age Periods—White Males 21
7. Number of Individuals Reached, Together with Cases of Sickness Found in Seven Community Surveys, 1915 to 1917 23
8. Number and Percentage of People Ill at Time of Visit, New York 24
9. Comparative Frequency of Various Diseases Found in First Million United States Draft Recruits, 1917-1918 26
10. Defects Recorded in Final Report of Draft Examination 27
11. Percentage of Persons in Specified Age Group Showing Important Physical Impairments 28-29
12. Number of Deaths and Death-Rates for Principal Causes, Registration Area in Continental United States, 1921 and 1922, Together with the Percentage of the Total 32
13. Losses Due to Ill Health—Cheney Brothers 46
14. Qualifications for an Industrial Physician 65

15. Character of Mental Defects among Those Called for Army Service during the Great War 119

16. Lost Time as a Percentage of Total Factory Hours, 1923 127

17. Sickness Experience of the Edison Company, Boston, 1918 to 1922 128

18. How the Menstrual Period Affects the Women Employed in a Large Department Store 136

19. Number and Percentage of "Heart Cases" Found in Certain Industries 137

20. Number and Percentage of Male Cases of Venereal Diseases in Various Occupations 146

21. Cases and Deaths from Occupational Poisons, New York State, 1912 to 1923 152

22. Occupational Diseases Reported to the Ohio State Department of Health, 1921-1923 153

23. Deaths from Lead Poisoning—United States Registration Area 164

24. Attack Rate for Various Industries 165

25. Cases of Lead Poisoning Diagnosed in Various Occupations 166

26. Number of Cases and Deaths Caused by Lead Poisoning in England in 1923 166

27. Symptoms of Lead Poison in 2,700 Cases; England, 1910-1914 169

28. Mercurial Poisoning in England, between May, 1899, and December, 1918 174

29. Principal Sources of Industrial Poisoning from Carbon Monoxid 178

30. Poisoning in Germany from Hydrogen Arsenide 180

31. American Wage-Earners Employed in Dusty Industries, Trades, and Occupations 193

32. Ratios in Percentage of Tuberculosis Deaths to Total Deaths in Occupations Exposed to Mineral and Metallic Dusts—United States Registration Area ... 194

33. Mortality from Tuberculosis in Certain Occupations in the Registration States, for the Ages of 10 Years and Over, 1900 194
34. Occupations Found in a List of 621 Skin Diseases 200
35. Causes of Industrial Skin Trouble in England in 1923, as Reported to the Chief Inspector of Factories 201
36. Number of Cases and Deaths Caused by Anthrax in England, 1914-1918 203
37. Analysis of Impairments in Examination of Industrial and Commercial Employees by the Life Extension Institute 208-209
38. Classification of Disabilities of 10,000 Workers Into Six Groups 210
39. Defects Discovered in Examination of 547 Applicants .. 211
40. Applicants Examined and Rejected on Physical Examination—Ten Industries 226
41. Applicants Rejected on Physical Examination—Various Industries 227
42. Sickness and Accident Experience—Edison Electric Illuminating Company, Boston, 1918-1922 228
43. Diseases Causing Lost Time, 7,000 Males, 5,000 Females 230
44. Results of Eyesight Examination by Underwood Typewriter Company 239
45. Frequency of Eye-Strain in Various Occupations 241
46. Scale for Determining Percentage Loss of Vision 243
47. Analysis of Dental Work Done by 56 Firms 247
48. Work Done in 18 Dental Dispensaries for 1923 248
49. Cost of Operation of Dental Department 255
50. Relative Gravity of Industrial Injuries 260
51. Size of Emergency Room 264
52. Analysis of 50 Cases of Infection in the State of Pennsylvania 273

53. Expenditures of The Endicott-Johnson Company on Its Medical Work in 1922 275

54. Estimate of Expenses of Medical Personnel, and so forth, 1921 278

55. Accident Statistics, by Industry 280

56. Causes of Fatal and Non-Fatal Injuries in Pennsylvania from January to July, 1924 282

57. Average Number of Employees in the Metal Trades Injured per Day after Beginning Work, by Sex 283

58. Location of Injuries Causing Permanent Disability in the Iron and Steel Industry, 1910 to 1914 285

59. Accident Frequency Rate, by Nature of Injury, 1905-1914 Blast Furnaces; 13,840 300-day Workers 286

60. Relative Value of Different Phases of Prevention .. 290

61. Scale of Time Losses for Deaths and Permanent Disabilities 306

62. Fatalities and Disabilities in the Automotive and Metals Industries, 1923 307

63. Reduction in Frequency and Severity of Accidents, 1920, 1921 309

64. Compensation, Lost-Time Accidents, and Days Lost, 1918, 1919, American Rolling Mill Company 310

65. Reductions in Insurance Rates in Six Companies, 1922-1923 314

66. Time of First Indemnity Payment of Compensation for Injuries in Wisconsin, 1924 317

67. Ventilation in 54 Foundries 324

68. Relation between Output and Temperature 329

69. Range of Suitable Temperatures for Various Rooms ... 330

70. Temperature and Humidity in Relation to Working Ability 334

71. Ratio of Respiratory Diseases and Absence from Respiratory Diseases According to Method of Ventilation and Temperature of Rooms in New York Schools 340

72. Heating Systems in 54 Foundries 354
73. Minimum Allowable Foot-Candles of Light Intensity on the Space or at the Work 361
74. Effect of Illumination on Production 365
75. Results Following Improvement in Lighting in Nine Factories 366
76. How the Willys-Overland Company Supplies Food to Its Employees 371
77. Types of Lunch Service Found in 227 Establishments in 1918 372
78. Area per Employee to Be Provided in Plant Lunch Room 374
79. Dimensions of Typical Lunch Room 374
80. Size and Seating Capacity of Lunch Rooms in Various Plants 375
81. Lunch-Room Equipment 375
82. Types of Lunch-Room Management in Various Plants in 1918 377
83. Cafeteria Staff 378
84. Results of Lunch-Room Operation in 46 Companies ... 382
85. Rest Periods in Industrial Establishments, 1916-1917 . 397
86. Answers to a Questionnaire Relating to Rest Periods for Industrial Workers 397
87. Toilet Facilities Necessary for Each Specified Number of Men and Women 436
88. Washing Facilities in 409 Industrial Establishments, 1917 440
89. Requirements of Wash-Basins, with Hot and Cold Water 440
90. Cost of Towel Supply of the Metropolitan Life Insurance Company 444
91. Usage of Indoor and Outdoor Swimming Pools 451
92. Amount of Drinking Water Required in 24 Hours ... 468

FORMS

ENGAL

1. Card used for record of calls made by company nurse .. 73
2. Floor plan of emergency hospital of Pennsylvania Steel Company, Steelton, Pennsylvania 81
3. Plan of standard emergency hospital 86
4. Emergency hospital of the American Rolling Mill Company, Middletown, Ohio 96
5. Medical examination waiting-room and dressing booths ....between 218 and 219
6. Form used for physical examination report by the National Malleable Castings Company 224
7. Form used for recording dental examinations 254
8. Interior view of first-aid room ..... between 262 and 263
9. Dressing unit 264
10. Chart showing a typical reduction in the cost of accidents for nine months before and after passage of workmen's compensation laws in New York State ... 313
11. Chart showing relationship between temperature and humidity 336
12. Chart showing relationship between temperature, humidity, and air motion 338
13. Electrically operated monitor sash ... between 342 and 343
14. Interior view of the Ford Motor Company, River Rouge Plant, showing the use of steel sashes throughout .... between 360 and 361
15. Lunch-room layout 373
16. Plan of portion of first floor of Schenectady Works' restaurant, showing arrangements of tables, belt conveyers, kitchen, and route of patrons 380
17. Chart designed to show lines of investigation involved in fatigue studies and their several relations to the problem as a whole 388

18. Form used for recording results of a sanitary survey .. 417

19. Form used for weekly report of sanitation inspection .. 421

20. Standard sanitary unit for the accommodation of small groups of workers 423

21. Water-closet compartment 425

22. Plan showing urinal installation 426

23. Shower-bath compartment 429

24. View of wash-room of Norwalk Iron Works .. .. between 440 and 441

25. Interior view of wash-room, showing vitreous marble stands, tiled floor, wainscoting, and columns .... between 440 and 441

26. Shower-bath installation with wooden slat floors and hoods to carry off vapors .... between 446 and 447

27. Plan of swimming pool installation 450

28. View showing use of ceiling hooks for workmen's clothing .. .. between 458 and 459

29. Tilted jet drinking fountain ...... between 466 and 467

HEALTH MAINTENANCE IN INDUSTRY

PART I

HEALTH MAINTENANCE

ENGAL

INDUSTRIAL HYGIENE

Health, a great industrial asset. What is industrial hygiene? Its importance in increasing output. Improvement of machines or human beings. High sickness and death-rate among workers. The purpose of medical service. Relation to state health insurance. Unrest and sickness. The worker and his health. Sick benefits or prevention?

THE workman's only real asset is his health, upon which his strength depends; it is his working capital. When he loses health he loses everything; he becomes a burden to himself, to his family, his friends, and the community. He lives by the wages he gets just as employers live by the work he does. How to maintain health, under industrial conditions, is the subject now to be considered.

The term "Industrial Hygiene" is used much more today than at any time in our history. It signifies the dawning of a new era wherein the man, rather than the machine, receives the most anxious and skilled attention. The subject, according to a recent statement by the New York Division of Industrial Hygiene, "involves the medical, economic, and social conditions of the workers in industry." Like all new subjects, or old ones becoming prominent, industrial hygiene bears different interpretations partly on account of its newness and partly because of its varied applications in industry. For present purposes it is that branch of medical science which aims to conserve the health of the worker and increase his productivity; and this is accomplished through the agency of the plant medical service.

There is, of course, nothing new about all this. Ever since the time of the Industrial Revolution efforts have been made to provide the worker with some substitute for the loss of personal relations that existed in primitive industry.

We read, for instance, regarding a woolen mill in Kilkenny, Ireland, in 1817, that, "To provide against or to remedy sickness or bodily injury from accident, the services of an eminent Physician and Surgeon are engaged; and a distinct infirmary is about to be built on an appropriate and healthy situation." [1]

Because such experiments were scattered and novel they did not find universal acceptance in the factory mechanism until conditions, such as we have today, rendered them an obvious necessity. Within the last decade health conservation has become highly developed in some of the progressive plants of the country and the experience thus gained is now becoming available for all.

The department which at once aims to improve the health of the worker and to increase production thereby is variously known as: "Health and Sanitation," "Medical," "Health Service," "Industrial Health and Sanitation," "Employee's Service," and "Medical and Surgical," depending, to some extent, on the emphasis placed on some special phase of activity. At the Fifth National Safety Council Congress, "Health Service" was considered the most appropriate designation for such a department but, whatever title is used, the aim remains substantially the same. Industrial hygiene pertains especially to personal health while sanitation applies more immediately to the environmental aspects and hence is of less relative importance.

THE IMPORTANCE OF INDUSTRIAL HEALTH

Several recent circumstances fix attention on the importance of health maintenance in industry. An English periodical asks this pertinent question, "How far will increased efficiency methods enable British firms to compete successfully abroad?" The American manufacturer is, in fact, always in competition with the rest of the world for trade. If he fails to produce materials as good and as cheap as the foreign manufacturer he is inundated with competition; if he makes goods better and cheaper than the outsider he can export his surplus and keep his plant in continuous operation in spite of fluctuations in the home market. This happy state depends somewhat on two factors: improved machines and increased output of the workers.

---

[1] *A Sketch of the Present State of Ireland, by an English Traveller.* Dublin, Nov. 14, 1817.

Machine improvement. Each year shows a substantial increase in machine productivity in which the brains of the scientist and the technician and the money of the capitalist are used liberally. Thus, America competes successfully with the other countries of the world. But while machinery goes on improving to an extraordinary degree, the human machine appears to be undergoing positive deterioration in spite of a general decline in the death-rate. The very effort made to produce better machinery has brought about the neglect of those who build and use it.

Work today and yesterday. One has but to consider industrial history to see why a departure from traditional practice in health maintenance is the need. In former days work was performed without the stress and pressure of today. Man generally did his work in the open air; he had more personal volition and mingled with his friends who were his fellow-workers, if at all, in small groups. Occupational risks, chemicals, fast running machines, belts and wheels were hardly known and the worker was, perhaps, generally healthier and happier in production than now. The death-rate was high, it is true, but not from occupational causes. Modern industry has changed all that. We live in a period of mass production, which means a mass of human beings as well as a mass of production, and with the human cooping up involved there comes a problem of ill health and unhappiness which demands rectification.

Industrial workers have a higher sickness and death-rate than those in agricultural pursuits, yet their services, as regards the value produced, are far more important. Nowadays nearly every plant has some hazard of employment none the less acute because it is unrecognized or ignored, as in a recent case where a new substance, tetraethyl lead, caused several fatalities. A machine, lacking oil and burning out, is rapidly repaired and the means for repair are immediately available because production must not be hindered. If the worker, on the other hand, gets sick, no such provision is made; he merely ceases to produce and another person is put in his place although the latter is just as likely to acquire the same disability.

Two important facts which have become clear in recent years demonstrate the need for health conservation. It was found that labor turnover was high and costly, and that productivity increased over a long term of years with most individuals. Hence, there has been a radical change of ideas in the handling of workmen. Instead of letting labor turnover go unchecked, employers have adopted the policy of maintaining their workers in steady employment. The employer, somewhat forced by lack of immigration, is now considering the maintenance of his labor force on a long, instead of a short-term, basis. For this purpose many different devices have been introduced, wage incentives, recreation rooms, athletics, stock ownership, and profit sharing, but they are futile unless backed up by health conservation.

THE PURPOSE OF MEDICAL SERVICE IN INDUSTRY

Medical service in industry has two distinct but intertwined aims. Its primary object is to increase production. Its secondary aim is to improve health and decrease disability as a means of securing its primary object; and it should be accepted or rejected on that basis. To have a clear idea of the object to be accomplished is to secure acceptance of a plan and to court success. Medical men are often so interested in the academic side of their profession that they are apt to overlook the practical side of industrial medicine. Without guidance they tend to forget that production is to be considered in all phases of their activity.

Many individual delays result from the operation of a medical department in a plant, and they are immediately apparent to the plant manager. He is not so familiar with the less obvious but far more serious delays due to absence from work on account of sickness. Physical examination of applicants delays men in getting to work while the foreman fumes and rants. The other side of the picture is that this temporary delay may result in a permanent employee, or in the exclusion of a heart-diseased applicant. If such difficulties occur it is plain that the operating staff is not clear either as to the aim or the means of how it is to be accomplished. It is better to delay a new man five minutes at entrance on employment than to have him continuously absent from sickness after employment.

It is just as important for the employees to understand why medical service is introduced as it is for the employer to establish a definite goal. If the case is stated frankly to the worker he is deprived of the usual grounds for objection so often advanced. By disclaiming any effort to put medical service on a paternalistic or philanthropic basis the employer can demand cooperation from the workers. The employer is making an investment on the same terms and in the same manner as for other plant activities and he expects a return from both. But while good business may be the governing reason for introducing a medical department into industry, the spirit with which it is conducted should not be commercialized.

THE PRESENT INDUSTRIAL HEALTH SITUATION

Industrial progress depends, in no inconsiderable measure, on the health of the employee, yet one looks in vain for a concerted health policy. The question whether industrial health shall be a plant or a state policy is still in debate. Some employers object to state industrial health insurance while others show a desire for its establishment. In the meantime progressive employers are solving the problem in their own way, while the unprogressive employer is providing the proponents of state health insurance with arguments for its adoption.

While the question of state health insurance is still in debate a constructive policy of health maintenance is making steady progress through a variety of circumstances. There is an enormous economic loss from preventable disease and death amounting to over three billions to which industry contributes, perhaps, more than its share, and there is an imperative need to reduce this great wastage. For the first time in history, too, industry has begun to feel the effects of the present immigration laws which promise to continue indefinitely. Thus, the need for conservation of industrial humanity is becoming clearer than ever.

STATE HEALTH INSURANCE

A battle of wits is in progress between those who think that state health insurance is the only way to improve health, and those who think that it can and should be improved by leaving the workers to themselves. The first group argues that, on past experience of workmen's compensation, employers will be stimulated to adopt methods of prevention by the penalties imposed by state insurance, and if precedent is a guide, it would seem to be true. However, this is an indirect method of approach to the problem which should be met directly.

Those who object to state interference take their position on several grounds. They claim it promotes class distinction, destroys the spirit of independence, interferes with religious liberty, establishes paternalism, and would cost the worker more than in present circumstances. To these objectors, state insurance is abhorrent, filled with the germs of socialism and unenforceable without the aid of police power; moreover, it would serve only a fourth of the persons coming under the law. Conditions, they believe, are all right as they are; there is not as much sickness as represented and, even if there is, the worker is well able to take care of himself—wants to do so, in fact. Besides that, they say, sickness is higher in countries where there is health insurance. Many of these arguments need not be taken seriously, but they represent a spirit which will fight state insurance to the last.

While the fight is in progress there is a well-marked movement to include occupational diseases within the scope of the workmen's compensation acts and the time may come when all diseases of industrial workers will be included. In Utah, for instance, a worker cleaning a flue inhaled some gas and subsequently developed tuberculosis for which he recovered a reward. But what is under consideration here has become an accomplished fact abroad; in Austria sickness insurance was started in 1888 and now workers of every kind are included in its operation.

The above are symptomatic of the need for some better methods of industrial health conservation, rendered acute by the chronic labor shortage and the ever increasing demand for more output per man. Man's full economic indispensability remains unrecognized until there is a labor shortage. Capitalize his income of, say, $1,200 and we find he is worth $20,000.

THE SITUATION IN THE PLANT

Any employer, ruminating on the prevailing discontent, who asks himself what the worker really wants can generally find part of the answer in the field covered by industrial hygiene. The worker wants adequate wages, but he cannot earn money while he is sick or debilitated; the worker wants reduced hours because he finds, while long hours increase his earnings, they affect his health. Above all, he wants good working conditions and continuity of employment. If industrial hygiene has any function at all it is to improve working conditions so as to maintain the workers' continuity of employment and remove the disastrous financial burden which every serious illness causes in the career of the employee.

One might easily underrate the relation between unrest and illness unless the real extent of the latter is known. A sick man is a discontented man; a discontented man is a potential striker. Few plant managers can tell offhand the average extent of absence or sickness in a plant since their minds are occupied with other things, while the worker takes all the risk, cost, and inconvenience of each disability.

Industrial sickness does exist to a considerable extent. Hardly a plant in the country has more than 90% of its force on the job any one day in the week, the remainder are absent through various causes, the principal one of which is sickness. Every time the worker gets sick he has a potential grievance against his employer; sometimes he is aggrieved because of his own hard luck; sometimes he considers the plant or the working conditions the actual or supposed cause of his ailments. Whichever is the case he is seldom so foolish as to ignore whatever health measures are offered by the employer which tend to re-establish his health and remove his discontent. Workers often declare that money alone interests them—put the money in the pay envelope and they will look after themselves—but they are wise enough to know that, when left to themselves, they are apt to economize on the doctor and that a plant medical service, always available, saves them much money and bodily suffering.

In Ohio, Dr. E. R. Hayhurst made a state-wide survey of the work place and the workers' health and found that, in over 1,000 establishments with 235,000 employees, there was an astonishing lack of proper means to provide for healthy, productive employees.

THE WORKER AND HIS HEALTH

Health is of vital importance to the worker. Good health means much more to the wage-earner than to a man with an assured income; the moment a wage-earner gets sick his wages cease while the salary of the executive goes on. It seems to be a curious injustice that a laborer, who can least afford it, has to lose wages while the salaried man is, in most instances, not so handicapped? Not only are wages lost by illness but medical expense begins at the same time and the consequent worry of both retard recovery when it should be hastened. These facts are often the underlying cause of strike. Men appear to strike for a wage increase; they need higher wages because their earnings have been reduced by sickness.

The worker is quite conscious of the importance of health. Fear of sickness is an abiding nightmare with him, yet no one is more prodigal of his health and strength than the worker. His ignorance keeps him at laboring work and the same factor operates in preventing him from conserving his health. He has, however, the will but not the means of keeping himself out of the doctor's hands.

For years the general health of the community has been improving, due to the decrease of small-pox, diphtheria, tuberculosis, and other diseases, and the average term of life has been materially lengthened. But that is not true of the working population. The death-rate increases over that of the general population at a time when the worker should be reaching maximum efficiency. The fact is that, under industrial conditions the health of the worker is deteriorating and this leads to an enormous though unperceived loss to every plant. Elimination of preventable sickness, through a plan of health maintenance, will compensate the employer for the expenditures involved.

LABOR'S HEALTH POLICY

The worker has not done much to help himself; he does not know how, nor has he the means. What efforts he has made have been in the wrong direction. He has centered all his efforts on compensation for sickness when he should have devoted his attention to prevention and cure. Few of us are aware of the serious efforts made by the workers themselves to secure protection against the losses due to sickness and their entire failure to adopt preventive measures, which is, of course, much wiser. A great many fraternal and beneficial organizations exist more for the purpose of providing cash benefits than for keeping the members in good health.

M. W. Alexander, in an argument against State Health Insurance presented at legislative hearings in New York in 1917, claimed that 11,000,000 persons in mutual benefit associations, 2,000,000 persons in industrial and other establishment associations, and a rapidly growing membership in trade unions had some form of sickness and life insurance. Dr. Boris Emmet, writing three years later, says, "No actual survey has ever been made of trade union sick benefit systems in the United States. A partial survey made in 1917 by the author of this article for the Bureau of Labor Statistics, in the manufacturing centers of New York, Philadelphia, Cleveland, Detroit, Boston, and Chicago, indicated that about one-fifth of the existing local labor organizations paid some kind of temporary disability benefits. . . . The extent of sick benefit systems among organized labor is, therefore, synonymous with the extent of sick benefit systems in unions affiliated with the American Federation of Labor. Of the 111 national or international organizations affiliated with the American Federation of Labor, 15, with a membership of about 250,000, have sick benefit systems. . . . It is estimated that the total number of trade unionists receiving cash sick benefits from their local and national organizations is at the present time about 750,000." In the year 1918, 3,260,068 members were affiliated with the American Federation of Labor and $1,329,826 was paid to them in disability benefits or at the rate of 41 cents per member, per year.

All this shows a disposition on the part of the worker to protect himself from the monetary loss due to sickness, but there is no evidence of any organized effort towards prevention. As Doctor Emmet says, "The value of trade union voluntary insurance is nil from the point of view of medical attention." The fundamental thought which drives workers to insurance against sickness and not to prevention is that the consequences are more apparent to him than the unfathomed value of prevention. Even if he thought of adopting prevention as a desirable policy the circumstances of his life and his work make it impossible, while it is correspondingly easy for the employer. In fact, force of circumstances leaves the field entirely open to the employer who wishes to grasp it.

A change is taking place in the traditional attitude of organized labor towards health conservation. On April 5, 1924, Mr. Samuel Gompers, president of the American Federation of Labor, at the opening session of the Conference Board of Physicians in Industry, said, "I urge that industrial medicine avoid the errors of paternalism and that it be truly scientific not only as to the contents of its own professional field, but as to the performance of its practical service as an agent of management." There is, here, a virtual acceptance of the physician in industry. Moreover, the possibility of adapting mutual benefit associations to prevention is being studied and, for a dozen years, the Joint Board of Sanitary Control has existed in the Cloak and Suit Trade of New York. Quite recently, too, the Workers' Health Bureau has been started to protect workers from the ravages of occupational disease, give health instruction, and analyze health hazards. The efforts of trade unionists, owing to the nature of their organization, can at best be only partly successful. In the large majority of plants trade unionists form only a small percentage of the working force and, moreover, to some extent the individual plant is a medical problem in itself.

Among unorganized labor there has been no concerted movement towards health conservation beyond an acceptance of that which the progressive employer has chosen to provide. The recent employee representation plans have, however, stimulated workers to cooperate, and even to advocate, more comprehensive plans for the betterment of health.

II

INDUSTRIAL MORTALITY AND MORBIDITY

A. Mortality among wage-earners. High death-rates in industry. Age and death-rates. Sex and death-rates. Hazardous occupations. Causes of death among workers. General death-rates and tuberculosis among males and females compared. Longevity in various occupations. Indoor and outdoor occupations. B. Morbidity. Sickness in the community. Community surveys. Army rejections. Defects found. Sickness in industry. Physical impairments. Absence and sickness. Accidents and sickness compared. Causes of sickness. General hazards. Industrial hazards. Cost of sickness. Responsibility. Health laws.

A. MORTALITY AMONG WAGE-EARNERS

Is industry really dangerous to health? This could best be proved, perhaps, if it were possible to compare the death-rate of industrial with non-industrial workers of the same age, class, nationality, and condition, and, also, by contrasting male and female mortality rates, on the assumption that males are more generally occupied in industry than females. Unfortunately such conditions are rarely available. Men and women of the same ages seldom do the same kind of work and the problem can only be approached indirectly.

The Metropolitan Life Insurance Company has compiled a series of tables showing mortality statistics of insured wage-earners and their families in the United States and Canada and these figures represent, for the most part, workers engaged in industry:

> All the important industries and occupations are represented. Laborers form the largest single group, followed by teamsters, drivers, and chauffeurs, by machinists, textile mill operatives, by clerks and office assistants in the order named.[1]

---

[1] Dublin, L. I. *Mortality Statistics of Insured Wage-Earners and Their Families,* Metropolitan Life Insurance Company, New York.

If the death-rate of the above can be shown to be higher, at working ages, than that of the general population, it would seem that industry is definitely dangerous to health and that, so far, the means, if any, have been inadequate to meet the situation.

TABLE I

DEATH-RATES PER 1,000 PERSONS EXPOSED, CLASSIFIED BY SEX AND BY AGE PERIOD[1]

White Lives in Experience of Metropolitan Life Insurance Company, Industrial Department, 1911 to 1916, and Estimated General Population of Expanding Registration Area, United States, 1910 to 1915

Age Period	Males		Females	
	M. L. I. Company	U. S. Reg. Area	M. L. I. Company	U. S. Reg. Area
All ages—1 and over	11.82	12.41	10.40	11.08
1 to 4....	12.69	12.28	11.75	11.28
5 to 9 ..	3.64	3.32	3.33	3.03
10 to 14 ..	2.32	2.29	2.16	2.12
15 to 19.....	3.76	3.72	3.58	3.45
20 to 24. .	5.97	5.42	5.27	4.96
25 to 34. .	9.24	6.81	6.70	6.10
35 to 44.. .	15.90	10.05	9.23	8.03
45 to 54 ...	23.64	16.03	14.37	12.58
55 to 64.....	40.03	29.88	28.98	24.48
65 to 74...	79.68	59.13	66.91	51.72
75 and over	145.13	138.72	129.16	132.99

Table 1 shows that, in all the working ages—15 to 64—there is a higher death-rate among insured wage-earners than in the general population of the United States Registration Area, and it should be remembered that the latter group includes some industrial workers. Is this higher death-rate due to the physique of the men who go into industry, or to the nature of the work, low wages, or wrong methods of living? There are many phases to this question but the fact still remains that the death-rate of the industrial population is decidedly higher than that of the rest of the country.

The above table shows no marked difference in the death-rate of each group under the age of 25, which seems to indicate that the families of industrial workers have no inherent weaknesses which would cause a higher death-rate later on. As the working years increase, say from 25 upwards, there is a great excess in the death-rate of the insured group over that of the general population. "At these age periods, the special stresses of adult life and of employment in arduous labor make themselves felt in the mortality experience of males in an industrial life insurance company." [1] It might be assumed with propriety that, since insurance is selective, there is even a higher death-rate among uninsured than among insured industrial workers, though conflicting interests of insurer and insuree would tend to maintain a balance.

---

[1] Dublin, L. I. *op. cit.*, p. 23.

MORTALITY IN RELATION TO SEX

Mortality rates of males, as compared with females, may indicate a significant divergence. Traditionally we should expect a higher death-rate for the "weaker sex," but satistics do not confirm this assumption. There is a persistently lower death-rate at all age groups for females as compared with males up to the age of 35, and thereafter the gap widens, the mortality for males increasing at an increasing ratio for all ages. It must be remembered that females are engaged at essentially different occupations from men and, as a rule, they are not the dangerous trades. It is signifi-

TABLE 2

DEATH-RATES IN SOME TYPICALLY HAZARDOUS OCCUPATIONS[2]

Cause of Death	NUMBER OF DEATHS Male	Female
Chronic lead poisoning	168	5
Mine injuries	505	3
Quarries	40	1
Machines	720	32
Electricity	421	8

---

[1] *Ibid.*, p. 24. [2] *Ibid.*, Appendix.

TABLE 3

METROPOLITAN LIFE INSURANCE COMPANY DEATH-RATES PER 100,000 FOR PRINCIPAL CAUSES. PREMIUM-PAYING BUSINESS IN INDUSTRIAL DEPARTMENT 1914 TO 1924

(Ages One and Over)

Cause of Death	1924
All Causes of Death	850.2
Typhoid fever	4.5
Communicable diseases of childhood	26.3
Measles	5.7
Scarlet fever	4.3
Whooping cough	3.5
Diphtheria	12.8
Influenza and pneumonia	84.5
Influenza	14.2
Pneumonia	70.3
Meningococcus meningitis	.6
Tuberculosis—all forms	104.7
Tuberculosis of respiratory system	93.7
Cancer—all forms	71.7
Diabetes mellitus	15.1
Cerebral hemorrhage, apoplexy	61.2
Diseases of heart	125.5
Diarrhea and enteritis	11.4
1 to 2 years	6.0
2 years and over	5.3
Chronic nephritis (Bright's Disease)	66.7
Puerperal state—total	17.1
Puerperal septicemia	6.6
Puerperal album. and convulsions	4.4
Accidents of pregnancy	1.6
Total external causes	77.1
Suicides	7.3
Homicides	7.2
Accidents—total	62.5
Accidental burns	6.4
Accidental drowning	7.3
Accidental traum. by fall	7.8
Accidental traum. by machines	1.3
Railroad accidents	4.0
Automobile accidents	16.0
All other accidents	19.8
War deaths	...
Other diseases and conditions	183.8

cant, however, that the death-rate among female wage-earners is higher than that of the general population.

The mortality rates of males at all ages, one and over, exceeds that of females by 14% and this is explained by the fact that men are almost exclusively engaged in some of the most hazardous occupations, of which the figures given in Table 2 are typical. These statistics merely prove that there is a definite occupational hazard in industry.

CAUSES OF DEATH AMONG INDUSTRIAL WORKERS

As a basis for discussion, the cause of death as a whole gives some indication of the relation between industrial and non-industrial hazards. The figures in Table 3 are taken from the Industrial Department of the Metropolitan Life Insurance Company, premium-paying business.

At first sight the relation between industrial hazards and death is not apparent. Industry is seldom a primary cause but it is an important secondary cause. The disease arises in some occupation; death results from the disease. Since "tuberculosis is still the chief cause of death among wage-earners," a comparison between industrial and non-industrial workers should show a difference in the death-rate.

In the *Report on the Condition of Woman and Child Wage-Earners in the United States* are found tables showing the tuberculosis death-rate per thousand among man and woman operatives, compared with each other and with non-operatives of both sexes.

TABLE 4

DEATH-RATE FROM TUBERCULOSIS, PER THOUSAND, MALE AND FEMALE OPERATIVES AND NON-OPERATIVES

Ages in Years	MEN		WOMEN	
	Operatives	Non-Operatives	Operatives	Non-Operatives
15 to 19	1.60	0.93	2.23	1.10
20 to 24	2.61	1.39	2.51	0.99
25 to 29	1.57	1.45	4.53	1.71
30 to 34	4.46	3.36	4.91	2.19
35 to 39	3.05	3.99	3.86	1.0[illegible]
40 to 44	3.02	1.52	2.35	0.23

G11095

Table 4 clearly shows that operatives, from whatever cause, suffer more than non-operatives, and that women of both classes are more susceptible than men to the ravages of tuberculosis. From an industrial view-point the eradication of tuberculosis is very important. The average age at death from this disease is 37.1, a time of life at which an industrial worker should be reaching his highest productivity. This compares very unfavorably with 47.9 which is the average age at death of all occupied persons. The frequency of industrial tuberculosis is principally due to the prevalence of dusty processes to which, perhaps, four millions of workers are exposed in varying degrees. It is of course true that industrial conditions are not responsible for all the tuberculosis that occurs among industrial workers.

TABLE 5

LONGEVITY IN VARIOUS OCCUPATIONS

Occupation	Average Age at Death
Bookkeepers	36.5
Enginemen and trainmen	37.4
Plumbers, gas and steam fitters	39.8
Compositors	40.2
Drivers and chauffeurs	42.2
Machinists	43.9
Longshoremen	47.0
Textile mill workers	47.6
Iron molders	48.0
Painters, paperhangers	48.6
Tobacco workers	49.5
Bakers	50.6
Railway yard workers	50.7
Coal miners	51.3
Laborers	52.8
Masons and bricklayers	55.0
Blacksmiths	55.4
Farm laborers	58.5
Average for all occupations	47.9

OCCUPATIONAL DEATH-RATES

Longevity in various occupations is shown by the list given in Table 5, compiled from *Bulletin Number 207 of the Bureau of Labor Statistics,* United States Department of Labor.

Bookkeepers appear to have a high mortality rate, or at least the age at which they die is lower than that in other occupations. To deduce, therefore, that bookkeeping is the most dangerous occupation would be wrong, since the average age of bookkeepers as a class is much lower than that of other occupations such as machinists or compositors. A factor that affects the showing is that the distribution of age of the living varies with each occupation.

Comparing one occupation with another it is found that in general the indoor, as compared with the outdoor, occupations show a higher death-rate. This difference is demonstrated by a study of the death-rates of machinists and farm laborers, (Table 6) and incidentally, it points out the importance of good air as a factor in health.

TABLE 6

NUMBER AND PERCENTAGE OF DEATHS FROM ALL CAUSES AMONG MACHINISTS AS CONTRASTED WITH FARM LABORERS, BY AGE PERIODS—WHITE MALES

Occupation	NUMBER IN EACH SPECIFIED AGE PERIOD					
	15–24	25–34	35–44	45–54	55–64	65 and over
Machinists .	573	565	500	509	516	489
Farm Laborers..	239	198	266	431	1,008	1,748

Occupation	PERCENTAGE IN EACH SPECIFIED AGE PERIOD					
	15–24	25–34	35–44	45–54	55–64	65 and over
Machinists.	18.2	17.9	15.9	16.1	16.4	15.5
Farm Laborers. . . .	6.1	5.1	6.8	11.1	25.9	44.9

Although the statistics in Table 6 lack the one fact which would give absolute comparison, that of the averages of ages of the living in each group, they are sufficiently startling to challenge serious attention. The term "Machinist" is subject to loose usage but, even allowing the inclusion of some semiskilled workers in this group, the disparity is remarkable. The machinist is essentially a trained man whose usefulness might be expected to continue till at least the age of 65 years. These figures disclose the fact that nearly 85% of them have died before that age. Stronger evidence of the need of health conservation in such occupations would be hard to find.

Dr. W. F. Dearden, an English authority, says, "The excessive amount of disability and loss of life from sickness among those engaged in industrial occupations is appalling, and can be accounted for (that is, the excess) by the association of deleterious conditions with the industries themselves."[1]

B. MORBIDITY

EXTENT OF SICKNESS IN THE COMMUNITY

The rate of mortality presents concrete evidence of the prevalence of illness and shows that industrial workers die early. It is much easier to secure accurate statistics of death than of sickness, but the decreasing death-rate can hardly be considered more than a *per contra* indication of increasing health. There is never the slightest doubt as to the fact of death; all sorts of questions arise as to the facts of sickness. Some persons are diseased without knowing it; others have imaginary illnesses, while some are ill, know it, and behave as if in good health.

The above considerations make it difficult to ascertain how much sickness there really is, but it is generally accepted that for every death two people are sick on the average, that is, about 3% of the entire population is constantly disabled. In order to throw more light on this subject the Metropolitan Life Insurance Company has made a series of sickness surveys among the general population, of which the following is a summary:

---

[1] "Health Problems Affecting Industry," *Welfare Work*, March, 1922.

TABLE 7

NUMBER OF INDIVIDUALS REACHED, TOGETHER WITH CASES OF SICKNESS FOUND IN SEVEN COMMUNITY SURVEYS, 1915 TO 1917[1]

Community	Individuals Reached	Cases of Sickness		
		Number	Percentage of Persons Exposed	Percentage Unable to Work
Rochester, N. Y.	34,490	798	2.31	1.92
Trenton, N. J.	6,971	180	2.58	1.98
North Carolina	66,007	1,881	2.85	2.29
Boston, Mass.	97,259	1,902	1.96	1.80
Chelsea District, N. Y.	24,043	359	1.48	1.38
Pennsylvania Cities	308,009	5,399	1.75	1.65
Kansas City, Mo.	34,267	862	2.52	2.38

These figures, collected by agents of the insurance company among wage-earners carrying industrial life insurance, are somewhat representative of the conditions among the general population. Without qualification as to age or length of disability, they show that, in a typical industrial community such as Rochester, 2.31% of the persons exposed were ill at the time of the investigation. Employers often complain of the absentee; a glance at these statistics show that absence is often due to sickness which, in some cases, results from conditions in the plant itself.

The Public Health Committee of the New York Academy of Medicine made a sickness survey in 1918 of 2,000 families and found practically confirmatory results. The figures in Table 8 distinguish between complete incapacity and incomplete incapacity. The former indicates a condition in which the person was ill, unable to work and to care for himself of herself; the latter indicates an impairment

---

[1] Stecker, M. L. *Some Recent Morbidity Data.*

TABLE 8

NUMBER AND PERCENTAGE OF PEOPLE ILL AT TIME OF VISIT, NEW YORK

Sex—Adults	Condition of Persons Ill at Time of Visit						
	Partial Incapacity		Complete Incapacity		Total Ill		Total Number
	Number	Percentage	Number	Percentage	Number	Percentage	
Males..	75	3.0	36	1.4	111	4.5	2,475
Females.	159	6.3	88	3.5	247	9.8	2,514

of the ordinary activities or some disease or condition for which treatment was being taken. The employer in the first case loses service and overhead; in the second he may be paying for labor which is only half as productive as it should be.

The Rochester survey showed that, out of 34,000 persons, 798 were sick, of which number 82% were unable to work, 18%, though sick, were able to work, and 10% were in hospital. The point of significance to employers is that while work may be interrupted by sickness, there are times when employees continue at work while sick. Under such circumstances they naturally fail to produce as much as in health.

An interesting fact, recently demonstrated by a study of the incidence of disease in Hagerstown, Maryland, covering 28 months in a population of 7,000 persons, was that over a hundred cases of sickness occur annually for each death that takes place.[1]

THE ARMY REVELATIONS

It is a truism that disease means death and the vast majority of deaths are preceded by sickness. Therefore, in order to avoid mortality the study and prevention of disease becomes of prime importance. It is obvious that it is easier, better, and less costly to prevent sickness in its earlier stages than later. This is a fact of peculiar significance to industry and it is thus desirable to examine the situation and to consider broadly the health of those who find their way into industrial occupations.

---

[1] Sydenstricker, E. "The Incidence of Illness in a General Population Group," *Public Health Reports,* February 13, 1925, p. 290.

Some employers still hold that medical work is far from being either a necessary or useful adjunct to the plant organization, reasoning that industry is concerned wholly with production and not at all with such extraneous subjects. This obsession arises from mere indifference or lack of knowledge and because it is overlooked that production can only be maintained by healthy and vigorous men. In some industries the labor shortage has never been so acute as to force attention to this fact, labor being generally plentiful and a constant stream of immigration having always ensured a surplus. Recent events have made a change. During the Great War, when the demand for soldiers and consequent production increased and, at the same time, when immigration practically ceased, a marked shortage of man-power developed. Moreover, those who went into the army had to be physically examined and thus came about, for practically the first time, a comprehensive knowledge of the physical status of those who, mainly, make up the working population of the country.

Between June, 1917, and May, 1918, over a million men were examined for the army and only 65% were accepted for military duties as qualified without defects; 29% were qualified with defects, and nearly 53,000 were rejected. Here is authoritative evidence of wide-spread physical disability which must be quite unrecognized in plants where there is no physical examination. It is true, of course, that the army and industry make different demands on the physique, but the requirements in each case are sufficiently close to make some consideration of the facts of value. Since an acute shortage of labor existed at the time the 53,000 men were rejected, it is quite likely the larger part

TABLE 9

COMPARATIVE FREQUENCY OF VARIOUS DISEASES FOUND IN FIRST MILLION UNITED STATES DRAFT RECRUITS, 1917-18

Cause of Rejection	Part I		Part II Men Rejected	
	Number	Per 1,000	Number	Percentage
Flat foot	176,424	177.45	2,496	
Venereal diseases (all)	28,826	29.99	1,217	
Throat diseases	24,132	24.28	47	
Gonorrhea	23,311	23.	490	
Inguinal rings	25,156	20.28	3,371	25
Hernia	13,709	13.79		
Vision, all defects	9,220	9.3	6,555	71
Heart, valvular disease	7,157		5,429	76
Feet, congenital defects	6,994		604	9
Teeth, D. or loss	4,923	4.96	3,371	67
Tuberculosis (pulmonary)	4,911	4.94	4,519	92
Syphilis (all)	4,459	4.49	1,530	35
Variocele Hemorrhoids and Varicose	3,318	3.34	116	3
veins	5,771	5.80	801	14
Otitis Media	2,589	2.60	1,914	74
Underweight	2,589	2.60	1,660	64
Ankylosis	2,584	2.60	926	36
Mental defects	2,431	2.45	2,333	85
Fracture (malunion)	2,015	2.02	1,045	51
Goiter (simple)	1,834	1.85	266	15
Testes (congenital defect)	1,882	.81	302	16
Skin diseases	,590	.58	69	4
Varicose veins	,428	.44	526	36
Eye (refraction error)	,408	.42	743	52
Epilepsy	,066	.06	1,028	96
Chancroid	,056	.06	107	10
Hemorrhoids	,025	.03	159	15
Physical development (defective)	799	0.80	652	82
Scoliosis	743	0.75	409	51
Asthma	622	0.63	552	88
Heart disease (functional)	604	0.61	308	50
Arthritis	595	0.60	449	74
Psychosis	594	0.60	569	95
Hearing, defective	579	0.58	368	63
Heart, hypertrophy—dil	526	0.53	307	58
Nose diseases	521	0.53	85	16
Trachoma	469	0.47	386	82
Nervous disorders (functional)	463	0.46	444	95
Goiter, exophthalmic	446	0.45	409	90
Cardiac Arhythmia, and so forth	396	0.40	308	77
Psychopathic (constitutional)	309	0.31	297	96
Drug addicts	286	0.29	270	94
Myocarditis	181	0.18	168	92
Alcoholism (chronic)	94	0.07	70	74

of the army rejects found their way back into industrial occupations without any discovery of their disability and, therefore, without any adjustment to the requirements of the job.

These figures are astonishing enough, but English experience has amply confirmed them. For the first eight months of 1918 the National Service Medical Boards examined 2,080,709 men and found not more than 37% in Grade I. Table 9 presents the comparative frequency of the various diseases found in the first million draft recruits in ratios per thousand.

This table shows that flat foot was the most frequent disability found. The army has to be particular about selecting men with sound feet, but the need is just as great in those industrial occupations which necessitate a standing position. Venereal and throat diseases come next in numerical importance, yet we hear little of venereal diseases in the plants of the country, perhaps on the theory that what is not found does not exist. Hernia, a disability of importance in different kinds of hard manual labor, is one of the most frequent defects noted.

The final report of the draft examinations showed that 486 men per thousand had defects worthy of record, as given in Table 10.

TABLE 10

DEFECTS RECORDED IN FINAL REPORT OF DRAFT EXAMINATION

Defects	Percentage
Mechanical defects, bones, joints	39
Defects of sense organs, eye, ear, and so forth	12
Tuberculosis and venereal diseases	11
Cardio-vascular diseases and defects	10
Developmental and metabolic defects	10
Nervous and mental defects	6
Diseases of nose and throat	5
Diseases of skin and teeth	3
Respiratory diseases	1
Other defects	3
	100

TABLE 11

PERCENTAGE OF PERSONS IN SPECIFIED AGE GROUP SHOWING IMPORTANT PHYSICAL IMPAIRMENTS

16,662 White Males in Metropolitan Life Insurance Company, Ordinary Department, 1921

Impairment	All Ages	Under 25	25 to	35 to 44	45 to 54	55 and
Persons in Specified Age Group—Number..	16,662		5,885	5,799	3,023	1,094
Persons in Specified Age Group—Percentage.	100.0		100.0	100.0	100.0	100.0
Weight:						
Over 20% underweight....	2.4	2.0	3.2	2.3	1.5	2.1
Over 20% overweight....	12.9	4.9	8.1	14.4	18.9	19.8
Eyes, Ears:						
Defective vision corrected	25.4	15.2	18.4	21.8	38.3	48.7
Defective vision uncorrected	29.5	28.3	28.9	30.0	29.4	31.8
Otitis media; discharging ear..	1.2	2.0	1.3	1.0	1.2	.5
Nose and Throat.						
Deflected septum—slight.	22.8	24.5	24.5	23.0	19.9	19.2
Deflected septum—marked	2.7	2.6	2.8	3.1	2.4	1.4
Enlarged, septic or buried tonsils	26.2	34.0	32.8	25.6	17.1	13.0
Naso-pharyngitis—chronic	5.5	4.9	6.0	5.4	5.0	4.4
Naso-pharyngitis—acute	5.5	6.5	5.5	5.5	5.0	6.2
Hypertrophic rhinitis—enlarged turbinates	14.8	19.0	16.9	15.1	10.7	10.1
Teeth and Root Infection:						
Carious teeth; septic roots......	8.5	6.4	7.9	8.1	9.2	13.0
Slightly infected gums......	10.3	3.6	7.3	11.1	14.7	16.4
Pyorrhea—definite.....	4.8	1.2	2.7	5.7	7.1	7.4
Heavy dentistry—X-ray advised	41.8	30.0	40.7	44.2	43.5	38.8
Heart and Pulse:						
Functional murmur or irregularity.	6.0	6.9	5.5	5.5	6.3	9.3
Mitral murmur—stenosis.	.2	.2	.2	.1	.2	.4
Mitral murmur—regurgitation...	.7	.3	.7	.5	.9	1.5
Aortic murmur—stenosis ...			.1	.1	...	.2
Aortic murmur—regurgitation.....					.1	.1
Enlargement...........		1.7	2.1	2.0	3.7	8.2
Slow pulse—below 58..........		1.4	1.0	1.4	1.7	1.9
Rapid pulse—above 90......		10.9	8.2	8.2	8.6	6.7
Intermittent pulse—extra systoles		.2	.4	.4		1.7
Blood-Vessels and Blood Pressure:						
Normal condition of blood vessels	77.4	89.5	83.6	76.6	71.6	55.2
Slight arterial thickening ...	14.3	7.2	10.9	14.9	18.2	24.0
Moderate arterial thickening...	4.6	2.0	3.1	3.9	6.5	13.6
Marked arterial thickening......	.6	.1	.4	.3	7	3.7

SICKNESS IN INDUSTRY

Coming now to discuss the more immediate question of industrial sickness we find that, whether it is ascertained by outside agencies or by the industries themselves, there is a large amount of more or less serious disabilities. The Metropolitan Life Insurance Company, for instance, has recently published a table showing the number of impairments, in different age groups, among 16,662 white males carrying ordinary insurance (see Table 11).

TABLE 11 (*Continued*)

PERCENTAGE OF PERSONS IN SPECIFIED AGE GROUP SHOWING IMPORTANT PHYSICAL IMPAIRMENTS

16,662 White Males in Metropolitan Life Insurance Company, Ordinary Department, 1921

Impairment	All Ages	Under 25	25 to 34	35 to 44	45 to 54	55 and over
Persons in Specified Age Group — Number.	16,662	861	5,885	5,799	3,023	1,094
Persons in Specified Age Group — Percentage.	100.0	100.0	100.0	100.0	100.0	100.0
Normal blood pressure. .	78.8	84.9	82.6	80.0	73.3	61.8
Blood pressure—20-40 above average	6.2	4.6	4.6	4.9	8.3	16.3
Blood pressure—40-60 above average	.7	.1	.2	.5	1.1	4.3
Blood pressure—60 or more above average.	.3	.1	......	.1	.7	2.3
Stomach; Abdominal Organs:						
Constipation.	39.7	34.6	39.5	40.4	40.1	40.3
Tenderness over liver and gall bladder.	.6	.1	.4	.8	.9	.7
Tenderness in region of appendix	2.3	1.7	2.5	2.5	2.1	1.6
Hemorrhoids	12.3	4.4	9.3	12.8	17.7	16.3
Abdominal Organs; Inguinal Region:						
Weak inguinal rings	5.9	5.8	5.9	6.0	5.9	5.2
Inguinal hernia—no truss	2.2	1.4	1.4	2.2	3.1	4.8
Inguinal hernia—truss worn	2.9	.2	1.4	2.6	5.1	3.2
Varicocele . . .	8.1	9.9	8.5	7.8	7.8	6.9
Genito-Urinary:						
Prostate gland—enlarged, hard, tender or boggy	3.9	1.0	2.0	3.1	5.6	15.8
Endocrine Disturbances.						
Enlarged thyroid—simple goiter .	2.1	3.1	3.3	1.6	1.1	.8
Miscellaneous Impairments:						
Headache	15.4	13.7	16.4	16.6	13.7	10.0
Use of patent medicines	8.8	6.3	8.9	9.5	8.5	7.4
Use of laxatives	9.1	6.4	7.6	9.1	11.4	12.6
Frequent colds . . .	17.7	22.9	20.8	16.4	14.2	13.6
Urinary Findings:						
Normal	74.1	72.6	75.2	75.4	72.4	66.8
Albumin—slight trace	12.2	11.6	11.6	11.8	13.5	15.1
Albumin—definite trace	2.3	3.3	2.2	1.7	2.4	4.9
Albumin—marked amount .	.8	1.3	.6	.7	.9	1.2
Sugar—trace . .	3.4	4.1	3.0	3.4	3.9	4.0
Sugar—marked amount (quantitative)	.4	.1	.2	.3	.9	1.0
Casts—granular or epithelial	.3	.2	....	.4	.7	.7
Casts—hyaline.	3.9	3.8	2.8	3.8	5.0	7.1
Indican.	3.7	2.9	3.8	3.8	3.5	4.2

These figures approximate the defects found among industrial workers; they show a large number of minor but more or less debilitating ailments which, in the interests of greater production, need constant attention among employees. They give evidence of the need of a comprehensive scheme for health maintenance in industry.

According to the 1923 Census of Manufactures, 8,763,233 wage-earners are engaged in industry. Of that number, it can be foretold to a certainty, about 10% are absent from work all the time and half the absences are due to sickness.

These figures do not, however, convey the full significance of the loss occasioned to the employer by sickness. From the fact that a wage-earner loses his wages while sick he remains on the job as long as he can and returns to work as soon as possible after a sickness whether he feels quite recovered or not. Many men, too, suffer from minor ailments which impair their efficiency, but they stick to work in order not to lose pay. We may have definite statistics as to the total absence from sickness and can, therefore, estimate the loss in production and overhead with some accuracy; but it is impossible to show the loss due to debility caused by slight ailments and by reduced physique which precedes and follows almost every sickness.

Many statistical estimates have been made of the amount of sickness prevailing in industry and it is generally agreed that about nine days are so lost per employee per year. Dr. B. S. Warren, of the United States Public Health Service, made an extensive enquiry into this subject for the Industrial Relations Commission and submitted a statement that, "Each of the thirty-odd million wage-earners in the United States loses an average of nine days a year through sickness." This finding is in accordance with that of the American Medical Association in 1919 and has been accepted as a fair average. Estimates of the kind vary from industry to industry, from plant to plant, from season to season, from age to age, and from occupation to occupation so much that it is imperative for each employer to ascertain the facts for himself in his own plant. We have been long indeed in ascertaining the extent of industrial sickness merely because there is no means of doing so unless a medical department has already been established. Very often an employer cannot be interested in the subject because he has no evidence at hand to justify the move.

In a recently published report on the *Incidence of Serious Morbidity among a Group of Wage-Earners*, it was found that, with an average of 75,191 workers, there were 7,357 cases of sickness and non-industrial accidents causing disability for eight consecutive days or more, in 1921. This rate, large as it seems, is a minimum, since, by the rules of the sick benefit associations reporting, certain ailments and chronic diseases are excluded. These workers were employed in 27 establishments, averaging 2,785 persons each; and, the number of cases, which averaged 97.8 per thousand, varied from 348.5 to 47.9 per thousand.[1]

SICKNESS AND ACCIDENTS IN INDUSTRY COMPARED

In the past decade enormous strides have been made in the prevention of accidents and the treatment of injuries but, will it be believed, the time lost from accidents in comparison with the time lost from sickness is negligible! There is, of course, some explanation for this strange circumstance. An accident is a palpable, immediate, and dramatic happening in the plant and unmistakably incident to employment. A sickness is an insidious and sometimes slow growth originating probably outside the plant.

Legislation has placed the responsibility for accidents squarely on the shoulders of the employer and he has, in consequence, taken comprehensive preventive measures and accomplished wonderful results; accidents have been avoided and the cost substantially reduced. Doubt as to the place or origin of sickness has prevented the imposition of laws such as in the case of accidents.

Dr. C. O. Sappington, in an exhaustive investigation made as to lost time in the Edison Company of Boston, made the following statement: "The Edison experience has shown that sickness causes 20 times as many cases of absentism as accidents and is responsible for 7 times as much loss of time from work."[2] In the experience of four Rochester plants in 1923 the percentage of lost time due to accidents was 0.13, and to sickness 3.04, that is, 23 times as much time was lost through sickness as through accident.

---

[1] See also, "Frequency of Disabling Sickness, among Industrial Employees," *Public Health Reports, No. 44,* October 31, 1924.

[2] Sappington, C. O. "A Five Years' Sickness and Accident Experience in the Edison Electric Illuminating Company of Boston," *Journal of Industrial Hygiene,* July, 1924, p. 94.

THE CAUSES OF SICKNESS

General causes of sickness. There was a death-rate in 1922, of 11.8 per thousand within the death registration area of continental United States. There were 1,101,863 deaths recorded. A summary of these causes indicates

TABLE 12

NUMBER OF DEATHS AND DEATH-RATES FOR PRINCIPAL CAUSES, REGISTRATION AREA IN CONTINENTAL UNITED STATES, 1921 AND 1922, TOGETHER WITH THE PERCENTAGE OF THE TOTAL

	Deaths in the Registration Area (exclusive of Hawaii)					
Cause of Death	Number		Rate per 100,000 Population		Percentage of Total	
		1921		1921		
All causes.	1,101,863	1,032,000	1,181 7	1,163 0	00 0	100 0
Diseases of the heart.... .	154,495	139,264	165.7	157	14 0	13 5
Influenza and pneumonia (all forms)	124,441	88,456	133 5	99 8	11 3	8 6
Tuberculosis (all forms)	9,452	88,135	97 0	99 4	8 2	8 5
Nephritis..	82,518	75,696	88 5	85 4	7 5	7 3
Cancer and other malignant tumors.	80,938	76,274	86 8	86 0	7 3	7 4
Cerebral hemorrhage and softening	80,191	74,111	86 0	83 6	7 3	7 2
Congenital malformations and diseases of early infancy..	72,940	74,791	78.2	84.3	6 6	7.2
External causes (suicide and homicide excepted)... .	65,263	60,896	70 0	68 7	5 9	5 9
Diarrhea and enteritis (total)	36,873	45,837	39.5	51 7	3 3	4 4
Arterial diseases, atheroma, aneurysm, and so forth. .. .	20,826	19,377	22.3	21 9	.9	.9
Diabetes mellitus...	17,182	14,933	18.4	16 8	6	4
Syphilis.	15,360	14,252	16	16.1	.4	.4
Diphtheria..... . .	13,659	15,683	14.6	17 7	.2	5
Appendicitis and typhlitis .	13,229	12,809	14.2	14 4	.2	2
Suicide (total) .	11,053	11,136	11.9	12.6		
Hernia and intestinal obstructing	9,844	9,509	10.6	10.7		.9
Puerperal causes other than puerperal septicemia.. . . .	9,322	8,970	10.0	10.1		
Respiratory diseases other than pneumonia (all forms) and bronchitis	9,301	8,730	10.0	9.8		
Bronchitis	8,740	8,014	9.4	9.0		8
Homicide (total)..... . .	7,788	7,545	8.4	8.5		7
Typhoid and paratyphoid fever .	6,981	8,007	7.5	9.0		.8
Cirrhosis of the liver. .	6,977	6,598	7.5	7.4		6
Paralysis without specified cause..	6,107	5,526	6	6.2		5
Puerperal septicemia.... . .	5,835	6,057	5.7	6.8		.6
Whooping cough.....	5,220	8,070	5.6	9.1		

many of the diseases which are found to affect industrial workers.

It will be seen, from the above figures, that diseases of the heart form the principal cause of death if we except the respiratory diseases. It will not be surprising to find that the same diseases affect industry, although the hazard of life and not industry is mainly responsible for them.

External hazards affecting industry. Many hazards, entirely unconnected with industry, affect the capacity to do a full day's work. Although the worker is a relatively short time in the plant he suffers a higher accident rate than outside, but this is not the case with sickness. The worker's own physical condition, resulting from heredity, bad living, and so forth, may make certain types of labor positively dangerous. Tuberculosis may occur in, and result from, home conditions but the disease limits production just as surely as if contracted in, and resulting from, employment.

A certain class of employees devote as much energy as possible to amusement and as little energy as possible to the work for which they are paid. They come to work like poisoned pups, as G. H. Lorimer once described the office boy, and quit like roaring lions. But the employer is ignorant of this because he lacks the only kind of control which will enable him to detect the physical condition of the man who is as much a danger to himself as to the plant for which he is supposed to work. Excessive amusement applies as much to women as to men. It is not uncommon to find young girls who go out every night for amusement and have little energy for the daily work. Their health thus becomes impaired; they are subject to disease and secure the employer's sympathy merely because he does not know where the blame truly lies. He feels he has enough to do to watch production and has no time to consider health problems on which production depends.

Industrial causes of disease. The last few years have added many and unusual hazards to work. Often they have been unrecognized either by the employer or by the worker. The latter knows neither the cause nor upon whom to place responsibility. In war time it was not unusual to establish new processes without knowing they involved the manufacture or use of deadly poisons. New machinery is frequently introduced without any special study of its dangers especially because the time of its introduction is one of expansion and also because the employer is unaware of the dangers. The result of such conditions is that many preventable disabilities arise.

The necessity for low unit cost of production is always present, only varying in degree in times of expansion and depression. When there is expansion the employer needs production primarily; he can afford to give high wages because he gets high prices and can sell all the goods he makes. The result is that the worker is driven, willingly it may be admitted, to the utmost of his endurance. When, however, the opposite phase of the cycle is reached, the employer who still remains in business, needs production at a lower unit cost. In either condition of the market it is evident the worker cannot do what is expected from him unless he is in good health. When business is expanding, labor is short and men of any kind will be hired whether they appear to be physically fit or not. Thus the ordinary conditions of business constitute a continual hazard.

Specific industrial hazards. Industrial hazards are numerous but ill defined. Anything that occurs within the industry which impairs the health of the worker may be considered a hazard of employment. Nearly all modern industrial operations necessitate the use of some material, machinery or process which affects the health more or less. A substance, harmless in itself or in small quantities, becomes a hazard on a commercial scale. We breathe air containing dilute poisonous gases without discomfort or danger which, in concentration, quickly cause death. Strychnine in minute doses acts as a tonic, yet it is one of the most dangerous poisons known. The miller may handle flour every day with impunity, but the flour mill contains two significant industrial hazards. A fly-wheel run at low speed is safe; at high speed it may cause a disaster.

Dr. F. J. Monaghan has enumerated the health risks of industry as follows:

1. Dust, either organic or inorganic, fumes, gases, vapors and acids, poisonous and non-poisonous
2. Harmful bacteria causing infections
3. Improper lighting
4. Improper ventilation
5. Excessive strain, leading to fatigue, and so forth
6. Extremes of temperature and humidity
7. Compressed or rarified atmosphere
8. Unguarded, poorly taken care of, or carelessly operated machinery
9. Fire hazards

From the first group occur what are known as the occupational diseases. Few industries are carried on without the use of some poison or the generation of gas, fumes, or smoke the dangers of which are seldom discerned. Heat, humidity, drafts, dryness or dampness, when existing in excess, lessen productivity and occasion disability in marked degree.

The occupation itself, even surrounded by hygienic conditions, when carried on at excessive speed, or in a cramped or fixed position, causes fatigue and predisposes to sickness. Overcrowding and contact with other workers, themselves diseased, are further sources of danger.

THE COST OF INDUSTRIAL SICKNESS

The cost of ill health is almost incalculable. We know the immediate cost accurately enough, but hardly an illness occurs that does not involve much more than a loss of wages. A worker gets sick and goes home; his wages cease just at the time when he incurs the unusual expense of a doctor. The employer loses production and overhead if the worker is not replaced; or, a substitute has to be found, selected, supervised, and trained if production is to be maintained. Thus the employer loses considerably more, though relatively less, than the worker.

If the nine million wage-earners in industry lose nine days each at a cost to themselves in wages of, say, $4 a day, the aggregate amounts to $320,000,000 in wages alone. Medical attendance adds up another $100,000,000. This loss may be made up, in part, by overtime and Sunday work though not to any considerable extent. The monetary losses are large, but the accompanying mental and physical anguish, which accompany them, diminish the will and capacity to work and make it improbable that the lost output is made up by more intensive effort.

The English Industrial Welfare Society estimated recently that British industry loses, through diminished effort due to indifferent health or actual illness, no less than $10,000,000 a week and the interesting claim is made that proper medical supervision could reduce this vast sum substantially.

For every dollar lost in wages the employer loses three times as much in lessened production and increased overhead.

Sickness and accident cost. Great efforts have been made in the last decade to prevent accidents and cure injuries arising from them. In all this work most gratifying results have been obtained. Some employers took up the matter without compulsion; others had been forced to give the subject attention by the introduction of the workmen's compensation acts, but in each case the benefit was the same. Before this period the employer shifted his responsibility and paid the bill to the casualty insurance companies. Later, when legislation forced him to deal directly with the subject, he manfully accepted the responsibility only to find greater effectiveness and less cost than by the old, irresponsible way.

Howell Cheney, in advocating health supervision in industry recently, suggests that the employer should consider the following items in estimating his losses due to sickness in industry: (*a*) the cost of training new employees to replace those whom death or disability has removed; (*b*) the cost of idle machinery; and (*c*) the extent to which production has been reduced because of the lowered vitality of workers who have been ill. The total amount of these losses, in their own establishment, has been estimated by Cheney Brothers to be $267,500 per year, or approximately $60 per person.

RESPONSIBILITY FOR INDUSTRIAL HEALTH

After all, where does responsibility for the health of the worker lie? Upon this subject the *Modern Hospital* makes the following significant statement:

> Who is responsible for the health of the worker in industry —the state, the employer, or the employee? To this question various answers have been given. The collectivist, believing in social responsibility, argues for paternalistic control; the individualist, on the other hand, true to his principles, pleads for a minimum of governmental or other interference. Through the clouds of discussion there may be discerned a general approval of efforts to enhance the worker's efficiency, while in actual practice there is a steady drift towards industrial organization for the promotion of health.

The Committee of the Association for Labor Legislation believes that responsibility for sickness may with justice be divided among three parties—the employer, the workman, and the state. Under ordinary circumstances the health of the individual is a federal or community problem, but, what is the use of that unless the obligation is discharged? The care of the health of a very much mixed, widely scattered population is a big job and not to be undertaken lightly on account of the cost and other administrative difficulties. But, in the meantime, the manufacturer must live and produce. The health of the worker is an immediate issue to be met from the time the whistle blows in the morning till the gate closes at night. Besides that, for eight or nine hours a day the workers are gathered together in an environment and under conditions which make them amenable to the application of health measures to a degree and under vastly more favorable circumstances than can be handled by any outside agency.

It is obvious that the employer is not responsible for many of the ailments from which workers suffer and there would be little reason for interesting himself in the problem if the worker would look after his own health, or if the community, as a whole, did its part. But, under present circumstance hardly any other course is open than for the employer to shoulder the responsibility.

Sickness, some forms of it particularly, is a grave menace. A man with a large family is stricken with typhoid or tuberculosis through no fault of his own. Who is to blame? Who is to take care of him? Who is to take care of his family while he is ill? These are questions involving much responsibility and cost, but the answer would not have to be given had education been provided against disease. This, one might say, is a community problem and the point is well taken, but it does not alter the fact of the disease and its consequences. Why should industry, then, suffer? There may be no logical, but there are several practical, reasons why an employer, for his own protection, for that of production, should do what he can without undue cost, within the sphere of his plant.

Public-health work is necessarily limited. It can reach only a small number of people, since they are scattered over a wide area. It gets to the people in their homes, if at all, when the wage-earner is in the factory and thus he is outside its educative influence. If public-health work is brought into the plant it is generally inadequate to cope with the special problems of industry and it is bound to be intermittent at best.

Foregoing the question of responsibility, the employer occupies an advantageous position with respect to the whole subject. In the first place his interest lies in the maintenance of the health of the worker. He can, as the worker cannot, pass the cost on as a charge against production, a plan already followed with accident costs and now regarded as quite the proper course. More salient is the fact that the workers are a homogeneous group gathered together for the greater part of the day and, if not engaged in exactly the same occupations, are at least working under the same atmospheric and physical conditions. Thus, they are so placed that a definite plan of health betterment may be worked out to the greatest advantage and without much cost or effort. In such an environment the application of standardized medical principles and practice are a possibility. It is also possible to give major consideration to minor ailments, a plan impossible of accomplishment under any other circumstances. The responsibility may not be the employers' but it may be advisable for them to accept it.

LAWS AND THE HEALTH OF THE WORKER

An increasing volume of labor legislation, all over the country, indicates not only that working conditions are still considered unsatisfactory but that there is a general tendency to remedy them by legislation. These laws have their origin not from within the industries, but from the outside; hence much of the legislation is regulatory, indefinite, general, and often inapplicable.

Laws relating to health cover a wide range; from child labor to hours of work; from safety to ventilation, with a general ameliorative tendency. In some cases they precede the need; in others they follow. Every new disaster, such as the coal dust explosion in March, 1924, has prompted fresh safety regulations that should have been in force before the event.

Besides federal regulations nearly every state is busy placing health laws on the statute book. New York had 68; Iowa, 24; Minnesota, 21; Ohio, 13; Connecticut, 11, in all over 200 state laws, for the first half of 1923. These were only a few of the multitude that were proposed.

Thirty-eight states have now passed maternity and infancy acts; 23 states have passed new laws against tuberculosis; and 19 states have passed laws concerning food and drugs. The general tendencies displayed are to decrease hours, prohibit child labor, improve safety and sanitation, and liberalize workmen's compensation acts. As typical of the last, a bill was passed, April 8, 1924, reducing the non-compensated waiting period from 14 to 7 days, and there is a wide-spread movement to include occupational diseases within the scope of the compensation acts.

The enactment of all these laws provides a bewildering problem for the employer and often constitutes an unhappy solution of his difficulties. Health laws, from their nature, must be general and indefinite. Factory inspectors, who have to apply them, are often unacquainted with the particular problem of each plant and are, in any case, more interested in the application of the law than in its ultimate effect. Laws of general application are apt to work injustice. Being indiscriminate they are too stringent for some and not severe enough for others. They place the onus of interpretation on the employer and leave him in doubt, though willing, as to what he should do.

Liberal employers find little guidance from state or municipal regulations, having gone much farther than the law requires, but they are nevertheless subject to capricious inspection. They are largely victims of a situation caused by the backward employer who does nothing unless compelled. It is regrettable that such employers exist, for otherwise there would be small occasion for the passing of regulations.

III

MEDICAL SERVICE IN INDUSTRY

Origin of medical service. Its extent. A sign of progressiveness. Preventability of sickness. Justification for medical work. Reduced sickness and prolonged lives. Cost of absence, and lowered production. Is medical service necessary? Its scope and aim. Medicine, surgery, hygiene, and sanitation. Family medical service.

ATTENTION to the physical situation of the worker has its origin in a need which has become more apparent with every step in industrial development. Yet medical service might not have been accepted in industry for another generation without a fortuitous circumstance. It was providential that accident prevention introduced the doctor into industry just at the right time. Nothing less than a flank movement of the kind could have brought about such a radical change in factory routine. It was easy to show that prompt attention to injuries effected a great saving and thus the doctor's reputation became secure.

As a result of this departure it was inevitable that the doctor should busy himself with the cure of sick workers. Sickness is more prevalent in the plant and, in any case, nine-tenths of the apparatus and equipment had already been provided. When, later, state health insurance became an issue, and the extent of industrial sickness became known, its systematic treatment became part of the regular work of the surgeon.

Industrial medical work has, thus, had a steady if uneven growth. In public and state service there is a fairly definite trend. Recently the employees of the postal service, in 57 cities, it was announced, would receive free medical examination when desired under a plan worked out by the Post-Office Department. Another evidence of the gradual broadening of the field is that shown by recent events in the state of Massachusetts. The Industrial Accident Board there provides for reasonable medical and hospital care, and this is the general tendency.

ITS PRESENT EXTENT

A revolution of ideas is taking place in industry. Had any one proposed, even a few years ago, that a medical man should be one of the regular staff of all large plants, he would have been looked on as a visionary. But the impossible has almost been accomplished, and we now find medical and hygienic science being developed in some well-managed plants in the country. The medical department is, in fact, a sure sign of progressiveness. One can hardly mention the name of any conspicuously successful plant in the country without finding that it has a well-managed medical department. The time is not far off when all large plants will have to follow suit.

Several comprehensive efforts have been made to ascertain the extent of medical and surgical aid in industry. The United States Public Health Service, in the first six months of 1918, made an investigation covering 150 establishments in the eastern and middle-western states. The National Industrial Conference Board made two surveys in January and May, 1921, the results of which are published in its bulletins Numbers 35 and 37. The Industrial Board of Pennsylvania in an investigation made February, 1923, of 457 establishments employing 225,000 people, found doctors in 104 establishments. There were 84 nurses, 52 had physical examination on entrance for employees with re-examination in 45 cases.

Public Health Bulletin Number 99 shows that, in the 155 establishments investigated, there were 138 dispensaries; 20 consulting, 68 whole-time, 50 part-time, and 37 physicians on call; there were 81 trained female, 6 experienced female nurses, 28 experienced male and 4 trained male nurses together with a staff of 57 clerks. Thirteen dentists were employed in these establishments.

The extent of medical work in industry varies naturally with the business cycle. It flourishes exceedingly in times of expansion and dwindles to small proportion in depression. In spite of these fluctuations there is no doubt industrial medicine is expanding and will, in time, cover every plant of any size.

Medical service in individual plants has gone quite beyond the experimental stage, but its growth has been individual rather than collective. Nevertheless it spread rapidly during the crucial years of the war here as in other countries. Dr. R. S. Hutton, at a recent meeting of the British Institute of Metals, called attention to the notable fact that, before the war, only 25 concerns in England gave attention to such matters but that since the war, there are perhaps 1,000 such firms.

In the United States the general drift and methods of industrial medicine are now taking shape. The movement has had little artificial growth. Its spread depends almost solely on the initiative of the employer, and it has been developed to meet an evident need. It now remains to consolidate the gains, by a systematic study of experiences and interchange of information.

THE PREVENTABILITY OF INDUSTRIAL DISEASE

Industrial medicine, it should never be forgotten, operates on the theory that disease is preventable; in fact, preventability is the foundation of the scheme. The only question is one of extent and the evidence in this particular point is not precise.

Mr. B. J. Newman, in the *American Federationist*, November, 1919, says that every year industry in the United States loses through illness 280,000,000 working days and that, "more than half this loss is unnecessary." Dr. F. L. Hoffman believes that one quarter of industrial sickness is preventable. Dr. E. L. Fisk, medical director of the Life Extension Institute, in an examination of more than 10,000 industrial workers, found that more than half of the discovered ailments are preventable. The American Medical Association investigated community sickness and found an average of 9 days lost from work each year, half of which is preventable. Dr. Cary McCord, writing in the *National Safety News,* made the following statement:

> But, while the information is variable as to the extent of general preventability, we find signal proof of the fact in such companies as the National Cash Register Company where the rate is 1.5 days lost per person per year among 6,000 employees.

The medical profession has hitherto been engaged mainly in curing diseases. Can it prevent their occurrence? We are all aware of the adage that, "Prevention is better than cure." But does that apply to industrial conditions, and can the principles of prevention be adopted by a profession whose whole trend of thought has been applied to cure? The answer to both questions is, of course, "Yes." Not only can a doctor prevent sickness more easily than he can cure it, but the nature of such sicknesses as are found in industry and the environment of the plant are specially adapted to the gospel of prevention. This is one of the salient facts and if the plant doctor cannot accommodate himself to its practice he had better not engage in industrial medicine. The employer naturally desires to keep the worker continually at work, and the physician's success must be gaged by how far he attains that end, not by his success in curing patients.

THE JUSTIFICATION FOR MEDICAL EXPENSE

It is not impossible to justify the application of medicine to industry by actual figures. Dr. Otto P. Geier, in describing industrial health conditions in Cincinnati, found that almost invariably the sickness rate had been cut in half and the lost time from infections to a negligible point.

Dr. Harry A. Mock, calling attention to the costliness of turnover, estimates that in rejecting 11,433 applicants employers saved over $400,000, and in placing the physically handicapped out of a total of 118,000 applicants, according to their physical needs, there was a further profit of $144,000. These, of course, are estimates but they are supported by actual records from plants where comprehensive facilities have been installed. In the National Cash Register Company, in 1921, only 11.5 hours were lost during the year by each employee, whereas the general average is about 8.5 days a year; but in this company absence of over 24 hours takes an employee off the pay-roll. The French had to abandon work on the Panama Canal on account of the destructiveness of disease. When the United States took up the work there was a death-rate of 41.73 per thousand in 1906. By 1917 the rate had fallen to 7.09 through the system of prevention instituted.

Perhaps the most remarkable achievement of industrial medicine comes from Messrs. Cadbury of Bournville, England, where the death-rate was 7.77, as compared with 13.7 in neighboring Birmingham, or nearly double the Bournville rate. In Bournville intensive medical work is carried on among the employees.

The justification for industrial medicine lies, however, not in reducing the days of absence from illness, important as that may be. A far more signal service is that of prolonging the lives and usefulness of the older and more experienced employees. We have no supporting statistics on this point, and it will be a long time before the ultimate effect of medical service can be appraised on such a basis.

Our present knowledge indicates that while the average life of the people as a whole has been lengthened in the last few decades, that of the industrial population has shown no relative increase. The blacksmith dies at 55 years of age, while the machinist dies at 44, eleven years earlier. If medical service can prolong the life of the skilled worker by even a few years the benefit to industry will be substantial. This is the desirable aim. The Pennsylvania Railroad Company, on May 1, 1924, announced that it had issued an offer to its 211,000 employees for a complete physical examination of each employee at least once a year in order to increase longevity and promote health. Events such as this show the importance now being attached to this subject.

Mr. Howell Cheney, of the Cheney Brothers, South Manchester, Connecticut, with an average of 4,500 employees estimates losses due to ill health as follows:[1]

TABLE 13

LOSSES DUE TO ILL HEALTH—CHENEY BROTHERS

Losses		Percentage of Total
Cost of idleness due to sickness	$ 67,500	11.9
Cost of absence from sickness	150,000	26.3
Production loss through sickness "on the job"	50,000	8.8
Loss to worker in wages	162,000	28.4
Loss through reduced earning capacity	40,000	7.0
Medical expense to workers	45,000	7.9
Public expense and charitable relief	56,000	9.8
Total	$570,000	100.0

It is not, alone, the reduction of the monetary loss, or the physical improvement of workers that justifies industrial medicine. The worker who knows that his health is protected, that his earning capacity is maintained and increased, and that he is in a measure relieved of medical expense, thereby gains in peace of mind which, in itself, is a factor in increased efficiency.

SOME FUNDAMENTAL REQUIREMENTS

Most medical departments are successful. If not, some fundamental, perhaps, has been overlooked. The establishment of a medical department should have been preceded by a thoroughgoing investigation as to the lack of medical facilities, the health of the workers and the need for additional service, expressed or implied.

---

[1] Cheney, Howell. "Industry Profits by Health Supervision," *The Nation's Health*, February, 1924, p. 94.

If health conditions are ordinarily good, if there is adequate medical service in the vicinity, if the employees are satisfied with the service and the cost, it would be absurd to provide any elaborate facilities. But conditions are not, as a rule, satisfactory. Medical attention, such as the worker can ordinarily command, is often good but inadequate, or vice versa, and sometimes it is poor in quality and quantity.

Any employer would be unwise to introduce a doctor into the plant unless he can do substantially better for employees than they can do for themselves. A medical department should supplement, not displace, the family doctor, and this situation should be explained to the employees. The service should aim only to improve health. It should not be used as a means of blacklisting workers on any grounds but health. It should neither patronize nor aim to censor morals or manners. In a word, it will fail unless the motives and spirit behind it are unquestionably sincere, apart altogether from the question of technical capability.

It is always advisable to begin modestly and expand slowly, taking the most obvious needs first and gradually enlarging as the necessity arises. Except in isolated plans there should be no attempt to follow the worker to his home. Nevertheless, the doctor cannot ignore the factor of living conditions. It is, at least, advantageous to attempt in the plant to educate the worker in the art of living hygienically in order to reduce the incidence of sickness in the plant.

There is no use trying to supplement an inadequate wage with medical service. Low wages mean a high sickness rate which may be mitigated, but not prevented, by a medical department. Collis shows,[1] for instance, a much higher death-rate from the respiratory diseases among unskilled than among skilled workers, and, in a recent study of disabling sickness among cotton workers, it is brought out that the rate of sickness per thousand increases as the weekly family income decreases.[1] It is significant, also, that infant mortality among wage-earners increases as fathers' earnings decrease.[2]

---

[1] Collis, Edgar L. "The General and Occupational Prevalence of Bronchitis, and Its Relation to Other Respiratory Diseases," *Journal of Industrial Hygiene,* November, 1923, p. 264.

THE SCOPE AND AIM OF INDUSTRIAL MEDICAL SERVICE

Industrial medical work differs in one respect very materially from general medical work. In general practice the doctor usually concerns himself with the cure of disease; in plant work the chief aim is prevention. The family doctor cannot prevent sickness even if so inclined. His patients wait till they are sick and, in many cases, only go to the doctor as a last resort. Besides that, patients are drawn from all classes and conditions and each one presents a new problem.

In industrial medical work all the potential patients are a fairly homogeneous group, gathered under the same roof and subjected to somewhat similar conditions for a substantial portion of the day. They can be more easily reached and influenced than when scattered in widely separated homes. The prevention of sickness is an economic as well as a humanitarian duty in the plant, and to be successful it must cover a wide field. Industrial-health work has four principal branches of activity:

Medical
1. Prevention of ordinary and occupational disease
2. Conservation of the health of the unafflicted employees
3. Restoration of the sick, by dispensary treatment
4. Health supervision of employees by:
    (*a*) Physical examination of applicants and employees

---

[1] "A Study of the Incidence of Disabling Sickness in a South Carolina Cotton Mill Village in 1918," *Public Health Reports,* July 18, 1924, p. 1736.

[2] "Infant Mortality," *Children's Bureau Publication No. 119,* p. 104.

    (*b*) Protection against contagious disease
  5. Visiting nurse for sick employees

Surgical
  1. Prevention of accidents
  2. Treatment of injuries

Hygiene
  1. Education of worker in health maintenance
  2. Supervision of diet and lunch rooms

Sanitation
  1. Supervision of working conditions
  2. Maintenance of sanitary appliances
  3. Supervision of housekeeping and plant cleaning

A complete system of prevention and cure may necessitate the adoption of any of the above and, in some cases, even more. Some well-established medical services include the use of a sanatorium; but, generally speaking, the more obvious needs are met first and the adoption of elaborate measures is a gradual development. Some plants are so happily situated that occupational disease is an unimportant factor; in modern plants the provision of sanitary appliances makes the question of sanitation one of minor importance. Where the plant is isolated the provision of medical service for employees and their families is a necessity. In the large metropolitan areas such a departure is out of the question. In a word, the scope of the medical department must be determined by local conditions, as well as by the character of the plant itself and the workers.

By its own nature medical service covers a wide and diversified field. It is concerned with the removal of any cause of sickness that hinders production whether directly or indirectly, whether inside or outside the plant. The only limitation is that determined by its efficacy in accomplishing the purpose for which it was established. Its object is to prolong the productive capacity of the workers through any and every means known to medical science which may be applicable.

Through medicine the desired end is sought by means of prompt and efficient treatment of minor ailments, by physical examination of applicants and workers, by the diagnosis and treatment of occupational disease, and by persistent and careful education in hygiene.

Industrial surgery aims to secure prompt and adequate first-aid for all injuries, to prevent infections and to alleviate suffering. It determines the need for supplementary dental or optical treatment and provides, by means of an emergency hospital, for the treatment of all injuries received at work.

In the field of hygiene the air is purified; dust, gases, and fumes are removed, mitigated, or rendered innocuous; the temperature is regulated; heating systems are supervised and the lighting system is adjusted to visual requirements. The food and food supply are supervised or controlled, drinking water is analyzed and purified when necessary, suitable recreation is inaugurated and encouraged, and bad housing conditions are improved if possible. The employee's working capacity is determined; he and the job are suited to each other and occasions for excessive fatigue are removed or modified.

MEDICAL SERVICE FOR FAMILIES OF EMPLOYEES

The question whether families of employees should be included in the scope of medical service depends on local conditions. It will generally be found that no company provides medical service for the families of employees unless there is substantial reason for doing so. Companies in isolated communities, those which are in a one-factory town, those localities where the medical service is inadequate or bad, seem to be fully justified in providing the families of employees with medical service; but there are exceptions. Endicott, Johnson & Company, of Endicott, New York, has three visiting nurses and gives obstetrical service free. It provides eye, ear, nose, and throat treatment for its employees' families. The Cutler-Hammer Company has visiting nurses. The Fulton Bag & Cotton Mill, Atlanta, Georgia, ministers to its employees, their wives and families, as does the Laurentide Company. In practically all of these cases local conditions demand the extension of medical attention beyond the plant.

On the other hand, most companies confine their attentions to the health of employees only. The B. F. Goodrich Company and the Norton Company, for instance, strongly object to any effort to infringe on private practice. The Goodrich Company, however, is among the few which extends medical attention to its higher officials. The International Harvester Company, the American Rolling Mill Company, and the Colorado Fuel & Iron Company provide medical advice for staff, and physical examination is, in some cases, compulsory. It is curious that this commonsense plan is exceptional. Employees naturally look with suspicion on a plan which applies only to them and does not include the higher officials who praise its benefits but do not use it. If health conservation is good for the rank and file it should also be desirable for the management.

Some employers have a rooted objection to extend medical service beyond the confines of the plant principally because they conceive the utmost limits of their obligation is filled by providing medical service for the workers in the plant. The case should not be decided on any such presumption. If there is a serious epidemic outside, an employer may find it very advantageous to extend medical service to a much broader field than originally contemplated. What really should decide the extent of the medical service is the conditions under which the plant and employees are placed. Medical service is not an obligation but a necessity.

IV

ORGANIZATION OF MEDICAL SERVICE

Its place in the plant. Investigating the need. Determining functions. Getting the work done. Placing responsibility. Coordination with production and employment departments. Size and type of medical department. Whole-time, part-time, or cooperative service.

It is quite unusual for employers to consider the medical department as an integral part of plant operation. Successful principles of plant organization are unapplied or misapplied in the creation of a medical department, yet it is fundamentally as much a part of the plant economy as any other department. If it has been found necessary to define the scope and limitations of each production unit, it is equally necessary when introducing medical work. There should be, as in fact there likely has been in the case of operating departments, investigation to determine the need, the cost, and the method of operation. There are several ways of doing this, and often the wrong and more expensive way is adopted. Some bright young man, knowing nothing of the subject himself, is commissioned to get the necessary information. He compiles a questionnaire and, if this is unsuccessful as it usually is, he visits a number of plants, spending much time and money in the process. This is not the best way; but it is better than going ahead without seeking for any information on how others manage.

The first step, of course, is to look inside and not outside. A full and exact analysis of the plant and personnel must be made before studying the problem in other plants. However, the difference betwen normal and abnormal conditions can hardly be ascertained without the aid of an expert. The abnormal health conditions in a plant demand attention first.

No medical department should be started unless a distinct need is shown. If, however, the ascertained facts justify the step, it then becomes necessary to provide the facilities, secure the staff, and assign duties. The employer should have clearly before him the whole plan. He should know what he wants to do, how, when, and where it is to be done. All these should be considered in the light of his own interest and wishes and those of his employees. To design that the medical department is established for the purpose of improving health to increase output, or merely the former (from which the latter inevitably results) narrows the issue and creates an objective so clear and simple that no misunderstanding can arise.

When the medical department has been established it should not then be left to sink or swim by the plant manager. It deserves his consideration just as much as any other activity in the plant. Its place in the organization should be defined, its rights and duties determined and, last but not least, each individual in the plant, as well as each newcomer, should be made aware of the facilities provided for him.

DETERMINING THE NEED

The usual difficulty in determining the need is that there are seldom any records for guidance; but absence of records alone is sufficient evidence. Often the situation is worse than suspected. Records of illness in other plants in the same industry, if accessible, should be consulted; they give a general idea of the problem and sometimes tell what to do and what to avoid doing. Even if the health conditions are unknown it may be assumed, from general experience, that health conservation is worth while and, therefore, attention may be concentrated on the methods used in other plants by some one with experience in industrial medicine.

It should hardly be necessary to say that it is desirable to ascertain the view of employees to the proposed innovation. The spirit of the times demands it. Not only that, but many useful suggestions come from employees. Some may be apathetic because they have not experienced the benefits to be derived. Their interest can be stimulated by means of judicious use of the plant periodical. Difficulties and misunderstandings have always come where a medical department has been planted on employees without consulting their feelings. The matter should be discussed, as soon as plans have been matured, with the older, steadier, and more faithful employees; if they are sympathetic the rest will follow. It is not enough to declare that medical service is for the benefit of workers; its character and methods should prove it to be so.

DETERMINING FUNCTIONS

As soon as the general scheme has been outlined, the functions of each person must be determined and the necessary equipment and apparatus provided. Precedent is here the best guide. It is, of course, a mistake to introduce an elaborate organization at once. It is much wiser to concentrate attention on the most pressing need first; then the others may be attended to in the order of their importance. Quick results are thus obtained, and they make the reputation of the department from the outset. If the accident rate is high and accompanied by numerous infections, proper surgery is the obvious aim; if occupational disease exists, attention should be promptly concentrated on a remedy, and so on.

Neither the plant manager nor the doctor alone can determine satisfactorily those functions to be performed. It is a joint responsibility. Usually, however, the matter is left entirely in the hands of the doctor; but this is a mistake even if he has had previous industrial experience. The doctor knows his subject and the manager knows the plant; the combined knowledge gives the best results.

A complete health department is composed of medical, surgical, hygiene, and sanitary branches or sections. It will not be difficult for the plant manager to decide on their relative importance from an operating view-point, or for the doctor to determine their relative merits from his experience. The surgical branch of the work is, as a rule, the first to be developed; the rest may follow gradually and it is safer to take months than weeks.

GIVING EFFECT TO FUNCTIONS

It is now the duty of the plant manager to make possible the performance of the functions decided on. There is no use in creating a plan without making its realization possible. This point is often neglected and then management is grieved because the plan has not been followed. Usually the full weight of authority is necessary to make a success of any innovation. If the plant manager has not taken the initiative he may be apathetic and his attitude will be reflected all along the line. If he shows an active interest the passive resistance of the workers will be easily overcome.

Too much importance cannot be placed on the attitude of the employer; if he has a sympathetic interest and is willing to go to the trouble, as some employers have done, of calling the workers together and explaining the project it will not be possible for the plant manager to resist the appeal either privately or openly. The plant manager, however, should be the person to take the initiative.

PLACING RESPONSIBILITY

In any well thought out plan it is not difficult to fix responsibility. Certain duties have been defined; they must be performed. It is only necessary to apportion those duties among the staff, each one doing that for which he has training and aptitude. There is, also, an obligation on the part of the workers; they will do their part if the matter has been fully explained, but it is not an uncommon occurrence to introduce a medical department without informing the workers. When the latter and the staff know their respective obligations, everything is likely to work smoothly. Full publicity should be given the plan so that each worker and foreman understands the situation. The foreman is often overlooked, yet he is in the most intimate contact with the worker and can make or mar any managerial plans. If foremen, as a class, are a little more intelligent than workers it is all the more reason that they should cooperate with the medical department. They are quite apt to see all of the bad points and few of the good things that a medical department can do for them. They are apt to object when a worker loses 15 minutes to undergo a physical examination, overlooking the fact that such a measure may result in more regular attendance.

COORDINATION

As a new activity in the plant the medical department will need coordination with the general scheme of things. This is the special field of management and there is no good reason why it should not apply to this new phase of industrial life. The doctor, himself, must cooperate. He should be amenable to industrial requirements just as the plant manager must accommodate himself to medical needs.

The physical examination, as far as the nature of the case permits, should fit in with the routine of the employment and operating departments. This means that the doctor should know something about plant operation and he should begin his tenure of office by making himself acquainted with the plant and its personnel. He will find it advisable to know the head of every department and to seek his cooperation, showing, at the same time, his willingness to fit in with departmental routine in order to get the best all-round result. Unless there is this close cooperation between them, the worker will find it possible to play one off against the other. The doctor will be told of delays in the shop and the foreman will be told of delays in the medical department; where coordination exists these cannot occur.

The employment and medical departments should be in close contact, working hand in hand. The employment manager ascertains the general capability and experience of the applicant; the doctor selects men for their physical fitness, and one is little use without the other. A preliminary selection of applicants is made in the employment office with the object of weeding out the obviously unfit in order to save the doctor's time, and the doctor, rather than reject the applicant selected, suggests to the employment manager alternative occupations. The health standard of individual applicants thus being raised tends in time to improve the average. At the same time the health of the older employees is being watched. The employment manager is, or should be, in close touch with the worker's point of view and this fact enables him to act as an adviser to the doctor in correcting plant conditions that might otherwise be overlooked.

THE SIZE OF THE MEDICAL DEPARTMENT

In organizing the medical department one of the problems is to determine on its size. A definite idea as to usage would be the best guide. Usage, however, depends not only on health conditions but on how far employees are encouraged to go to the doctor when in need. It is generally found that the greater the attendance the less percentage of sickness exists. Information as to usage is positive in a few cases. One large organization, with a specially well equipped medical service, has from 3% to 5% of its employees attending daily and the accompanying low rate of sickness shows that this is no mere waste of time. In another plant 95% of the employees have made three visits each to the medical department in the course of the year. Generally speaking, at least 25% of the total force may have occasion to visit the medical department each month. That is to say, with 1,000 workers, about from 10 to 30 visitors may be expected at the medical department each day, depending, of course, on the state of development of the service offered. Where attendance falls below 1% it is obvious that some publicity work as to the advantages of prevention may be advisable. In one case, where this was done through the medium of the plant periodical, attendance was increased from 651 in 1916 to 1,383 in the following year. The days lost on account of illness were reduced from 906 in 1911 to 193 in 1921. No employer who wishes to stimulate good-will can overlook the possibilities of the right kind of medical service. Each person who is treated promptly and properly in the medical department must come away with a favorable opinion as to his employer and the conditions of work.

TYPES OF MEDICAL ORGANIZATION

Before establishing a medical service it is desirable to review the different types in use. In general it will be found that the kind of organization in any given plant has been determined by the size and location of the establishment, and to a lesser degree, the personnel. The matter is simple for a large organization. They have, and it is best to have, a self-contained unit with a permanent staff on whole time. In addition there may be specialists—surgeons, oculists, and dentists—on call or part-time. It is less the usual than the desirable course to have a whole-time physician for establishments with an average of 500 employees, but generally one doctor and one nurse will be found sufficient for the routine medical and surgical needs of 1,000 men.

In the smaller plants, as originally in the larger ones, part-time medical service is relied on, but in the case of surgical work alone the plan has its limitations; workers have an uncanny way of getting hurt just when the doctor is absent from the plant. The difficulty about satisfactory part-time service is that surgical cases occur most frequently in the afternoon and medical cases in the forenoon, since people having acquired symptoms overnight are apt to seek advice in the morning.

An alternative is cooperative medical service just as there are cooperative employment bureaus in some places; where one exists the other is feasible. The condition necessary for the success of such a plan is that all the cooperating plants must be adjacent. If the doctor makes himself acquainted with the working conditions of each cooperator, small factories are just as well off as in the case of a large plant with widely separated departments.

Some of the mutual insurance companies maintain central medical and surgical service for cases from their clients' plants. This arrangement lacks the great advantage of immediate treatment. In case of an accident some one must give first-aid and largely on its efficiency depends promptness of recovery. The maintenance of a trained nurse on the premises, with a doctor on call, is not to be recommended or even justified except in the case of small plants. The nurse's job is to do what the doctor tells her and she cannot do that if the doctor is elsewhere.

In the lumber and iron regions of Minnesota, and the copper mines of Michigan companies provide medical service by the "Contract System." By this plan a doctor undertakes the medical and surgical care of workers and their families at the rate of about $1.50 per month and the money is deducted from the pay envelope of the worker by the employer. This system is almost the only possible one in an isolated community where public health and private medical work are not to be found.

For convenience, then, medical service may be classified on the basis of individual or group work as on the following page.

Individual service:
1. Whole-time
2. Part-time; mostly given to industry
3. Part-time; mostly given to private practice

Group service:
1. General supervision of plant
2. Surgical attention to employees who attend outside office

There are points for and against the whole- or part-time doctor. The only argument against a whole-time physician is one of expense, but cheap goods are bad goods as a rule. The part-time man, however, can keep in touch with the practice of medicine, but this is largely offset by ignorance of plant problems. In any case, when the functions of an industrial physician are considered, above-the-average knowledge of the plant is more important than above-the-average knowledge of medical technique. Part-time men, who gain most of their income from outside work, have little time or inclination for the study of plant conditions. Even whole-time physicians are sometimes known to overlook the need for acquainting themselves with the actual conditions under which employees work, due possibly to a lack of vision more than to anything else.

Under the influence of "employee representation" a new departure in plant medical work is evident. Joint committees, composed of equal numbers of employers' and employees' representatives, control the medical activities of the company. This plan, democratically conceived, tends to provide workers with the type of medical service which appeals to them most strongly.

THE WOMAN DOCTOR

A subject considerably discussed is the employment of a woman doctor. Girls who never dream of consulting a woman doctor on the outside plead for one in the plant. Where they are in the majority the services of a woman physician, if they can be obtained, are desirable though not specially necessary. If the number of female workers is small a local woman physician may be secured, if specially requested, and employed as a supplementary aid to the plant physician.

V

THE MEDICAL STAFF

Its character. The plant physician. His selection and qualifications. Conditions of employment and salary. Tests of efficiency. The nurse. Industrial or visiting. Qualifications and duties. Medical assistant. Relationships, in plant and outside.

SUCCESS of the medical department depends on the quality of the staff as much as on the cooperation supplied by the employer. There must be good team-work, a true idea of the objective and the proper attitude among the officials of the medical department. It is the spirit underlying the action and words that counts in the end. Since modern industrial medical work is somewhat of a new departure the necessity of which is but dimly recognized, it is often installed in a plant without sufficient knowledge of its scope or limitations. What was intended to serve as a benefit is only a cost to the employer and a vexation to the spirit of the worker. "Service" is a word casually used but the idea is all right. If the employer wants to have the proper service he must have the proper medium for its application. Hence the subject of staff is important.

The Conference Board of Physicians in Industry, in 1922, defined the physician in industry as follows:

> One who applies the principles of modern medicine and surgery to the industrial workers sick or well, supplementing the remedial agencies of medicine by the sound application of hygiene, sanitation and accident prevention; and who, in addition, has an adequate and cooperative appreciation of the social, economic, and administrative problems and responsibilities of the industry in its relation to society.

This definition provides us with an objective in our selection and the nearer the prospective medical director comes to it the greater chance there is of success, whether the service be full or only part time.

It is not, of course, easy to find such a man, or woman. Few medical men have the necessary industrial experience or adaptability; nor is it easy to attract one with a record of success in private practice. The American Association of Industrial Physicians, whose secretary is Dr. A. C. Colcord, of the Carnegie Steel Company, Clairton, Pennsylvania, probably has the names of men with industrial medical experience. The medical schools can sometimes provide the names of physicians who, in addition to a diploma, have some hospital experience. Universities like Harvard, which gives courses on industrial hygiene, are the best sources of supply for thoroughly trained men. Many plants have some connection with physicians in their neighborhood and there is an advantage in procuring the services of such men, provided their reputation with employees is good. Personal knowledge of a doctor, of his relations with workers, of his general reputation are important factors in his selection. A general practitioner has not always the most suitable training for plant work, since his attention has been concentrated on cure and not prevention. His ideas in this respect must undergo a change, but if he is adaptable and has extensive experience with workmen his services should be valuable in any plant.

SELECTION OF THE PLANT PHYSICIAN

It is the general, though not the universal, custom for the employer to select a physician without consulting the wishes, feelings, or desires of the employees. The argument for sole choice of a physician has less force than in the selection of any other important plant official. The benefits to be derived from medical service are dependent largely upon the confidence which the workers place in the, doctor; if they have some say in his selection they will be far less critical than otherwise.

Employee representation tends to make cooperative choice of a physician possible. The Colorado Fuel & Iron Company, for instance, provides for the joint selection of a physician by the employees' representatives and the representatives of the management. It is easy to imagine that this method secures more general approval than when the plant manager makes his individual choice. It is likely to benefit the service substantially.

As much or more care should be used in the selection of a doctor as in the case of any other important official, and the question of attitude is one of outstanding importance. The medical man going into industry for the first time needs to adjust himself to his new environment without which he will likely fail to achieve any substantial results. Those who took up this work at first were not very successful. The doctor tended to the academic; he treated his industrial clients as hospital subjects to whom the time factor was of small importance; he saw his duties from the large rather than from the minute point of view and, in consequence, he was slow in getting the worker back to work. There was a tendency, too, to study the effect of rare poisons rather than to relieve the common cold. But these phases are passing; the industrial physician is getting into his stride and he is realizing that his special function is prevention rather than cure. He pays particular attention to the minor ailments and the trivial accidents, realizing, as he should, that the more successful he is in prevention the less will he have to do in cure.

QUALIFICATIONS

The chief handicap in selecting a physician is that few precedents exist and the employer, who generally knows something of the work of an engineer, lacks any knowledge of the general qualifications for successful industrial medicine. Table 14, on page 65, is presented to act as a guide in the selection of a plant physician, but the fact that a practical rather than a theoretical turn of mind should exist must not be overlooked.

TABLE 14

QUALIFICATIONS FOR AN INDUSTRIAL PHYSICIAN[1]

Qualifications	Individual Score	Total	Minimum Requirement
Personal:			
1. Executive ability	7		
2. Initiative, enthusiasm	5		
3. Tact	5		
4. Broadmindedness	3		
5. Aggressiveness	3		
6. Perseverance	5	28	18
Moral:			
1. Integrity	10		
2. Character	10	20	20
Mental:			
1. Common sense	7		
2. Judgment	6		
3. Memory	2		
4. Literary ability	3	18	12
Physical:			
1. Health and energy	12		
2. Appearance	3		
3. Public speaking	3	18	12
Professional:			
1. General education	2		
2. Industrial medical experience	4		
3. General medical experience	5		
4. Special training in hygiene	5	16	8

What is needed is "a man's man" rather than one who is devoted to the scientific aspect of his work alone. "The real industrial physician must enter into the life and understanding of the plant." A "man's man," however, may not be a success with girl operatives or clerks.

It is hardly necessary to discuss each qualification in detail. In general, a doctor must be judged by his past accomplishments, but each qualification is set down with some application in mind. Literary ability is of use in the preparation of reports and especially in educating employees to look after their health. Such a faculty may be judged by correspondence and by the knowledge of contribution of articles to the press. The ability to speak in public is necessary in the plant and can be tested readily by having the candidate physician speak informally to the workers or superintendents. On such an occasion his personality, if he has any, will become evident and, as Dr. Otto P. Geier remarks, "Easily the most important qualification of a plant physician is his personality."

---

[1] "Rating for Health Officers," *American Journal of Public Health*, November, 1919 (adapted).

Dr. Carey McCord, in summing up the necessary qualifications, says the industrial physician must:

(*a*) Come to know that an industry is solely maintained to produce and that the doctor cannot make the plant over into a hospital;

(*b*) Have a knowledge, above all, of industrial hygiene, of physical working conditions, heating, lighting, fumes and dust, ventilation, locker rooms, wash rooms, rest rooms, cafeterias, toilet facilities, drinking water, and so forth;

(*c*) Have a fundamental knowledge of industrial relations, employment methods, race problems, mutual benefit, pensions and insurance liability;

(*d*) Have a practical knowledge of hours of work in relation to fatigue and output, shift systems, rest periods, absenteeism and turnover;

(*e*) Be familiar with systems of industrial training—apprenticeship systems, vestibule schools, and so forth;

(*f*) Know his job is to keep the worker on the job by maintaining such conditions in the worker's body and environment that his health will be kept intact;

(*g*) Be a "human being" knowing the hearts of these people as well as their hurts.

Finally, it must be remembered that management of a medical department demands some administrative ability, a quality often lacking in a doctor. In selecting a doctor this fact should be considered.

In hiring a doctor it is necessary to know that he has the proper credentials and state license. If, in addition, he has special training in industrial hygiene so much the better.

The Harvard University Medical School is the only institution which offers a doctorate on the subject, although the University of Cincinnati and, to a lesser degree, Rush College and the Ohio State University give some training in industrial hygiene. An increased demand would extend this field.

THE CONDITIONS OF EMPLOYMENT

In securing the services of a medical man it is necessary to be explicit about the conditions of employment. If the original plan has been well thought out it is easy to determine what is expected of the physician and what he should expect from the employer. The points which should be considered are:

1. Extent of general service to be rendered
2. Hours and time of attendance
3. Extent of service to employees
4. Extent of service to families
5. Fees, if any, to be charged
6. Use of automobile

The average number of employees on the pay-roll gives a good indication of the work to be done from day to day; the number hired daily indicates the number of physical examinations to be made and, hence, the amount of time spent in such work. The hours of work determine the duration of daily attendance. If the plant is small there will be opportunities for outside work and the conditions under which it should be done ought to be defined. A clear understanding should be reached as to the extent of attendance on employees outside the plant both as regards sickness and injuries resulting during work and those occurring outside employment. If fees are to be charged, the fact and amount should be a matter of record. If the plant physician is expected to attend workers and their families at their homes, it will be advisable and economical to provide an automobile. The details of these arrangements will depend on local conditions but their consideration should not be neglected.

SALARY

It is impossible to make any definite statement as to the salary which should be paid. Generally speaking what has been earned is an indication of what should be paid, but, on the whole, a plant physician has more constant and exacting work than an outside man. Physicians spend more time and money in gaining a knowledge of their profession than any other class in industry, and salaries, therefore, should compare favorably with those of men of somewhat similar capacity and training. The amount of the salary will vary, also, with experience, capability, and demand and, occasionally, with the opportunities afforded for supplementing income from outside sources. In contract work it is customary for employees to pay $1.50 a month for a broad medical service which includes families, but this system is confined generally to remote mining regions.

Another consideration is that reduction in lost time, the elimination of infections, and the reduction in compensation payments are a real saving to the employer and often exceed the cost of a doctor's salary in a plant of any considerable size. What the employer gains from increased output due to good health or from increased good-will with a properly functioning medical department cannot be calculated but it might be conceivably more than any mere monetary savings.

Minor disabilities of non-industrial origin, if not incapacitating, may be treated in the plant dispensaries, but services of such a character should not be charged to the worker. Any such effort on the part of the industrial physician is undesirable since the procedure may tend towards exploitation. On the other hand, it is inadvisable to send men to general dispensaries from the plant, because doing so wastes time and provides no corresponding advantage.

The importance of cooperation with local hospitals so as to ensure proper treatment should be considered. The plant physician should enquire into, and be able to decide upon, the relative merits of each outside institution to take subsequent care of his patients.

There exist in many industrial communities numerous voluntary health agencies, such as district nursing associations, tuberculosis and venereal disease clinics, and bureaus for occupational therapy and vocational rehabilitation. Industrial physicians have in most such organizations valuable resources with which to supplement the diagnostic and therapeutic facilities available in industrial medical departments.

TESTS OF MEDICAL EFFICIENCY

How is the employer, who generally foots the bill, to judge the capability of the doctor to do the work which he undertakes? Obviously the manager desires to keep himself informed as he does regarding the other departments. But he knows as little about medical work as the doctor knows about the running of the plant. The success of the other departments is judged by results and that is the way in which a doctor's capacity should be measured, as far as possible. The doctor, himself, is responsible for the compilation of those records upon which his performance is mainly based. If they are not compiled regularly and fully it is presumptive evidence of a serious lack of organization. The manager should receive periodic reports of what has been done each month, particularly as regards the following:

1. Percentage of absence due to sickness
2. Amount of lost time due to infections
3. Percentage of time lost due to accidents
4. Number of physical examinations made
5. Number of employees receiving treatment at dispensary

6. Number of plant inspections
7. Activity in educational work
8. Increasing length of employment
9. Decrease of compensation cost

Most of these may be called control records and the manager's need for them is that they keep him posted as to the progress of the work being done. Unless he insists on such control he will find the medical department decreasing in efficiency.

THE NURSE

Previous to 1910 only 66 industrial firms were credited with the employment of an industrial nurse. In 1920 no less than 891 plants had industrial nursing service, a very considerable increase in 10 years. Dr. C. D. Selby, of the United States Public Health Service, investigated 155 industrial establishments in 1918 and found that 81 trained and 34 experienced nurses were employed. In Pennsylvania, out of 457 establishments, 84 nurses were employed, in February, 1923.

An industrial nurse is a registered graduate nurse who devotes her exclusive attention to the physical wants of the employee in the plant; while the public health, visiting or district nurse attends to employees on the outside and their families. Either may be obtained from the National Organization for Public Health Nursing, 370 Seventh Avenue, New York, or from any of the neighboring health organizations.

Qualifications. The qualifications for an industrial nurse may be summarized as follows:

1. Personal—sympathy, tact, discernment, and patience
2. Moral—high moral character, testified to by recommendation
3. Mental—judgment and common sense
4. Physical—strength and endurance
5. Professional:

- (*a*) Registration certificate
- (*b*) Ability to keep and compile records
- (*c*) Several years' training in district visiting
- (*d*) Knowledge of industrial diseases, accidents, labor laws, hygiene, and employers' liability

Duties. The industrial nurse confines herself to the individual worker. The visiting nurse may include the family as well. Both have a distinct function as regards the doctor and the patient which the employer is apt to overlook. The duties of the nurse are:

1. To act under the physician's directions and carry out his orders;
2. To dispense, but not to prescribe or administer, treatment;
3. To relieve the doctor of routine work.

Other duties, which vary with the activity of the doctor and the size of the plant, may be enumerated as follows:

1. Medical
    - (*a*) Give medical first-aid
    - (*b*) Keep records of attendance at dispensary
2. Surgical
    - (*a*) Give first-aid
    - (*b*) Redressing, under orders
3. Hygiene
    - (*a*) Talks to individuals
    - (*b*) Group instruction in personal hygiene
    - (*c*) Inspection of lunch, rest, and hospital rooms
4. Sanitation
    - (*a*) Inspection of female sanitary appliances and locker rooms

At the plant of the Winchester Repeating Arms Company, "An important part of the medical department work is that of the matrons who make two complete rounds of the plant each day, each matron reporting to the hospital every 20 minutes her findings for the preceding period and her route for the next period."

Nurses should confine their attentions to the specified duties. It has not been uncommon to find unqualified women acting as nurses and taking liberties and risks which no properly qualified nurse would dare. This has become such a common practice in some places that a warning was found to be necessary. The secretary of the State Board of Health of Rhode Island has issued a notice that certain nurses are violating the Medical Practice Act by the treatment of injuries without the aid of the doctor. A nurse or "First-Aid" attendant is permitted to render any first-aid service possible in the event of an accident or disaster in case a physician is not available and until such time as one is available. Under these conditions a nurse may apply dressings or tourniquet or do anything else that she feels may be of service. She cannot, however, legally redress such wounds or combine treatment of the injured party except under directions of a licensed physician. By doing so, without direction, she violates the Medical Practice Act.

The industrial nurse does, and is expected to do, more than a nurse in private practice. She may, for instance, acting under the doctor's directions and orders, take temperature and pulse. Her function is to ascertain illness, not to treat it. Where the plant physician has introduced standardized methods of treatment, from which there should be no variation, the scope of the nurse's activity and usefulness is enlarged and she is virtually acting under directions all the time.

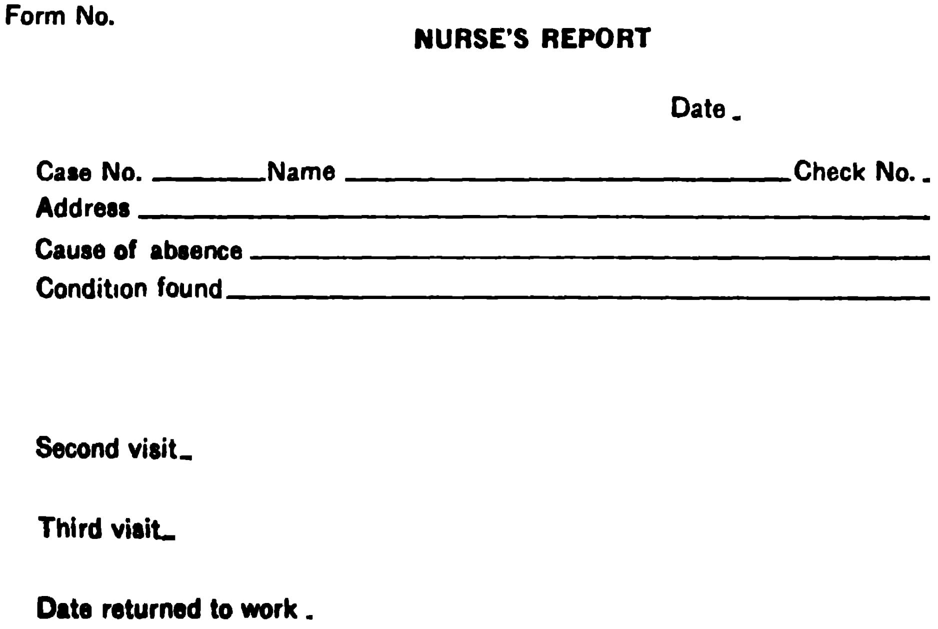
The duty of the visiting nurse carries her to the home of the patient. It may cover somewhat wider fields, such as:

1. Personal every-day care of sick
2. Disinfection of sick-room utensils
3. Household hygiene and management in sick room
4. Care of beds, bed making
5. Making the best of household materials in sickness
6. Feeding the sick, invalid cooking
7. Taking temperature, pulse, and respiration
8. Observation of the sick and note taking
9. Baths, cleaning, and fever reduction
10. Hot and cold packs, douches, poultices

11. Giving of medicine
12. Care in feeding of infants and children
13. Dealing with communicable disease
14. Household emergencies
15. Ordinary maternity nursing

Routine of work. The industrial nurse begins her morning's work by preparing reports of the previous day's work such as attendance, dressings, inspections, and health education. She prepares the dispensary for the day's work. She keeps a full supply of bandages and dressings always ready for the doctor's use and has all the necessary instruments clean and sterile. If circumstances permit she makes her routine inspections when the morning's work is over and when her services in the dispensary are not likely to be needed. As part of her work in health education she may give talks to different groups of workers on subjects outlined for her by the doctor.

The visiting nurse gets, each morning, from the employment office a list of absentees. These are at once followed up in case there is no definite knowledge as to the cause of absence, it being presumed that the absence is due to



Form No.

NURSE'S REPORT

Date _

Case No. ________ Name ______________________________ Check No. _

Address ____

Cause of absence ______________________________________

Condition found _______________________________________

Second visit _

Third visit _

Date returned to work _

Figure 1: Card used for record of calls made by company nurse

sickness. A report of the visiting nurse is then made to the doctor, and the employment department is notified of any medical causes of absence and their probable duration. The nurse keeps a record of her daily work and submits a weekly report of the number of visits. The use of a nurse for reporting absences of other than medical cases is apt to reduce her usefulness. Figure 1, on page 73, shows a type of card which may be used in recording visits.

A useful summary of what the visiting nurse is intended to do is the following, issued by the Colorado Fuel and Iron Company to all its employees:

INFORMATION FOR THE BENEFIT OF EMPLOYEES AND MEMBERS OF THEIR FAMILIES NEEDING THE SERVICES OF THE VISITING NURSE

The nurse is to tell and show—

1. How to prevent sickness and accidents
2. What to do in cases of sickness and accidents
3. How to care for the child in health and disease
4. How to prepare and care for cases of confinement
5. How to care for those suffering from acute and chronic diseases
6. How to treat wounds
7. How to keep the home sanitary

The nurse is provided, not as a charity, but as a part of the medical department service. She will be glad to respond, as far as she is able, to calls for her services in the homes of employees.

The nurse is not to take the place of the doctor, but to assist him.

She is not to treat contagious cases.

She is not to assume the place of a regular nurse and remain continuously on a case.

She is supposed to remain a reasonable length of time in cases of emergency, or until provision for the care of the patient can be made.

She is not to be called at night or on Sunday except in case of emergency.

She will be supplied with printed matter upon the care of the sick and wounded, for distribution among those interested.

At Pueblo the nurse may be called by communicating with the dispensary office or the Minnequa hospital.

At the mining camps where a nurse is on duty, she may be called by communicating with the doctor's office or the dispensary.

No charges are to be made for the nurse's services.

THE MEDICAL ASSISTANT

It is always desirable to relieve the doctor of as much routine clerical work as possible. In the larger organizations a medical assistant may do the double duty of relieving the doctor of routine medical as well as clerical work. In the smaller plants the nurse or some clerk may help in the compilation of the records under the directions of the doctor. Where no assistance is available the doctor must compile his own records but, if a clerk is employed, a sound first-aid training will enable him to assist the doctor intelligently.

The duties of an assistant may be summarized as follows:

1. First-aid
2. Care of goggles
3. Fire blankets
4. Superintend cleaning of hospital rooms
5. Preparation of hospital reports
6. Urinalysis
7. Keep stock of gloves
8. Prepare accident reports

These duties vary with the organization; sometimes being purely medical, sometimes combining medical with safety work, and at others, the clerical work is sufficient to absorb the whole time of an assistant. In the smaller plants the nurse is naturally the doctor's sole assistant, caring for the stock, doing the clerical work, and looking after the cleaning of the medical rooms. The main idea of having an assistant is to relieve the doctor of duties he is generally disinclined or unable to do competently, so as to permit him to do work for which he is specially trained.

THE MEDICAL DEPARTMENT AND ITS RELATIONSHIPS

The establishment of a medical department creates the possibility of many new relationships that need coordination to become effective. This is equally true of some of the older medical departments. It is a mistake not to make a systematic effort to organize these relationships. The medical department cannot neglect to overlook its points of contact with the various classes of officials any more than it can ignore the outside institutions and persons who are affected by plant medical work.

A doctor, desiring to run his department satisfactorily, must realize his position thoroughly. He is paid by the employer but cannot be successful unless he realizes that he is working for the employees and the more effectively he serves the workers the more he is truly working for the employer in the long run. The doctor, however, must be in constant touch with the plant manager not only to find out the latter's purpose but to show how far medical work can legitimately be made to serve the needs of production. Frequent meetings and consultation with the plant manager are almost a necessity.

The relationship with the employment department are more intimate and immediate. They are complementary rather than subservient to each other; forming, in fact, a partnership to serve the operating force effectively. Hence good team-work is essential, and this is easily accomplished by proper organization. The employment manager cannot hire a man for a job without the assent of the doctor who passes on the applicant's physical fitness any more than the doctor can pass a man who is unacceptable to the employment manager. When both are satisfied, relationship with the foreman then commences. Too frequently the foreman is ignored by the doctor, but since there is no other way of keeping track of the worker the need for stimulating the foreman to act as a connecting link between the worker and the doctor is evident. A man may start work in a job while physically suited to it; yet he may develop a condition which necessitates a revision of medical opinion. It is in such a connection that the foreman can be of use. Foremen need much coaching before they can become efficient cooperators with the medical department. No doctor can expect it without having had an opportunity of meeting the foremen, singly and in groups.

The relationship with the worker, medically speaking, should be confidential. It is the doctor's function to prescribe the type of work, not to tell the employment manager the symptoms or the diagnosis. In fact the diagnosis is peculiarly the property of the doctor and no reasonable person could demand information as to diagnosis when what is wanted is something else. When a doctor tells others what is wrong, not what a worker should do, he shows a fundamental lack of ethical sense.

Whether medical work is confined to the plant or not, contacts with the outside are necessary, such as cooperation with other physicians, medical and surgical institutions, medical departments of other plants and the community.

OUTSIDE CONTACTS

The family practitioner sees nothing, as a rule, in plant medical work but a loss of patients. His jealousy is frequently founded on a misconception. He does not know that the sphere of the medical department ends where that of the family doctor begins, and this ignorance of the purposes of industrial medical work creates an antagonism which hurts both.

To dispel the antagonism of the outside doctors is advisable. The plant doctor should be on friendly terms with the outside medical men, who might be invited to see the medical department, and to learn the aims and objects of industrial medical work. This lays the foundation of an alliance the object of which is to secure proper treatment of workers in or outside the plant. A committee of the

American Association of Industrial Physicians and Surgeons made a report on May 22, 1922, which places the relationship of the two parties in its proper light. This report says:

> It is not the reasonable and proper responsibility of an industrial physician to treat cases of a serious or incapacitating illness of non-industrial origin, except under unusual circumstances. . . . Minor disabilities of non-industrial origin if not incapacitating, may well be treated in the plant dispensary. . . . Services of this nature should not be paid for by employees. . . . The procedure tends towards exploitation of workers and is to be condemned.

Adherence to this policy helps to make cooperation with outside men possible.

It is not only desirable but advantageous to create and maintain close relation with all outside local institutions where cases from the plant are likely to be sent. The plant doctor should know their advantages and shortcomings so that he should be in a position to secure the best kind of treatment for critical cases. Visits to such institutions may thus bring about important results in restoring patients to their health.

Cooperation with the medical departments in adjacent plants leads to improvement in technique and service. Comparison of notes between plant doctors on short-service applicants leads to a knowledge of physical idiosyncrasies that, while possibly operating to exclude, may serve to secure the proper placement of certain individuals. It is, however, in the improvement of operating practice that conference between plant physicians finds its greatest advantage. The means for conference in a larger way is through such institutions as the American Association of Industrial Physicians and Surgeons of which every plant medical official should be a member.

Health work in industry is complementary to community health work, of which it is an intrinsic part. If community health service is inadequate the plant doctor is working uphill and he will find it advisable to busy himself with the larger problem. In the vicinity of most plants will be found numerous agencies interested in community health which may be mobilized to serve the interests of the plant. The Colorado Fuel & Iron Company, in its effort to promote the health of its workers, receives valuable aid from outside agencies with which it heartily cooperates. Physicians of the company are on various joint committees of sanitation and health created under the employee representation plan and their recommendations have brought about substantial improvements which of necessity have reacted favorably on the health of the employees. Under the direction of the Y. M. C. A., woman community secretaries render valuable aid in social service and in the promotion of hygienic living. Through the domestic science department valuable lessons in health education are given to the children of employees in the schools.

Industrial medicine should aim to supplement not supplant public-health work. Its aim should be to secure adequate health work outside the plant rather than to undertake the work itself. In some places public-health work is well developed and needs only cooperation to make it effective. The New York State Department of Labor has recently expanded its Division of Industrial Hygiene and seeks to encourage the cooperation of industrial medicine, without the help of which it is powerless for good.

> This division gives expert assistance on matters relating to mechanical appliances for the removal of health hazards resulting from injurious dust and fumes. It also contributes assistance in ventilation, heating, medical, and hygienic problems. . . . In order to proceed with the enquiry into the morbidity of industrial diseases in the state, it will be necessary to enlist the interest and help of those members of the medical profession who are associated with industry, for this knowledge does not seem to be procurable in any other way.[1]

It seems obvious from the above that the doctor who neglects to organize his relationships is missing many chances of ultimate success.

---

[1] *Weekly Bulletin of the Department of Health*, March 15, 1924, p. 83.

VI

THE EMERGENCY HOSPITAL

Character and functions. Nomenclature. Determining its size and location. Construction and plans. Waiting-room. First-aid room. Operating and ward-room. Service rooms. Equipment. Furniture, instruments, medical and surgical supplies. Medical forms and records. Typical plant hospitals. Extent of usage.

THE plant hospital should be, in name and in fact, an emergency hospital, serving only those who need immediate attention until they can be returned to work or sent to places where serious cases can be adequately treated. The industrial hospital is not new, having been instituted in some isolated plants years ago as a matter of necessity. It is only in the last dozen years that it has become at all usual.

The emergency hospital varies in character just as industries vary. Some are particularly devoted to the relief of injuries, others to physical examination or medical care. The purpose of the hospital, which should never be overlooked, is to render immediate and effective first-aid for medical and surgical cases, and to provide for the physical examination of applicants and employees.

A well-rounded emergency hospital consists of the following:

Medical:
   1. Consultation, or doctor's office
   2. Dispensary and treatment room

Surgical:
   1. First-aid room
   2. Physical examination room

Special:
   1. Dental office

2. Room for treatment of eye, ear, and throat
3. X-ray room

General:

1. Ward
2. Rest-room
3. Record-room
4. Waiting-room

In medium-sized plants (500 to 1,500 employees) there is no need for having so many rooms. In the small plants, by regulating the time, only one room is needed, for physical examination in the morning and for first-aid and dispensary work later in the day, and for clerical work at any opportunity that occurs.

In the larger plants (2,500-5,000 employees) use will be found for all the rooms, specially in isolated communities where hospital service is lacking in the immediate neighborhood. In some places, where serious accidents may occur, an X-ray room and ward with a few beds are desirable. In a few plants dental work is a specialty and should be provided for. Where clerical work is heavy, a special room may be provided for a stenographer and for the medical records.

The size of the emergency hospital must be determined

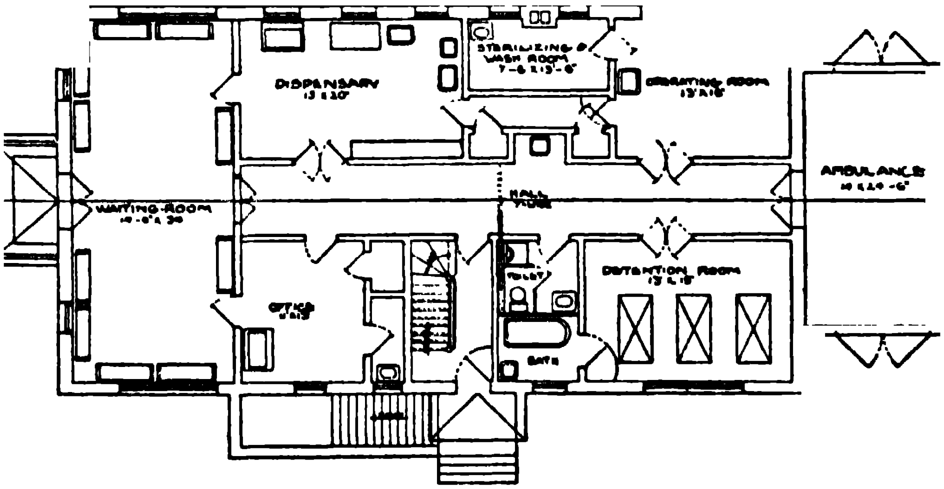


Figure 2: Floor plan of emergency hospital of Pennsylvania Steel Company, Steelton, Pennsylvania

by studying present and future needs. Its capacity will be gaged first by the average number of employees, their sex, and finally, by the nature of the industry. It will be seen that a census of employees is the first necessity. Then follows a study of turnover records, the number hired each day giving some indication of the space to be devoted to the physical examination. A study of the number and gravity of accidents gives an idea of the equipment and space for the first-aid room. It is also useful to know at what time accidents most frequently occur. The sickness rate varies with the age and sex of employees, being somewhat higher for males than females and for older than younger employees. The absentee records give some indication of the sickness rate since it is known that about half the absentees are sick. Though the above factors vary in intensity from place to place, such general indications are of use. It has been found, in some plants of different character, that about 25% of the total force goes to the medical department for treatment each month. That is to say, if the total force is multiplied by three the answer gives the approximate annual attendance. By dividing the total by the average number of days worked per year we get the average daily attendance.

The hospital should, as far as possible, be located in the middle of the plant, or rather, in the center of the plant population. Since about 25% of the employees are expected to visit the plant monthly, the proper location of the emergency hospital may save much time. But other factors must be considered. If there is a good general hospital near at hand on the outside, provision for serious cases is hardly necessary and minor cases can be taken care of in any convenient place. If there is not a good hospital in the neighborhood it is somewhat advisable to have the medical department near the entrance so that no time need be lost in handling serious injuries. Another advantage in locating the medical department near the entrance is that the doctor is on hand to take care of the physical examinees and to keep in close contact with the employment office.

As between the entrance gate and the center of the plant as a location for the medical department we have to consider the nature and the permanency of the medical work. If there is to be a physical examination of all employees, as well as of entrants, it may be desirable to have the work done in the center of the plant with provision for a physical-examination room in the employment office where applicants can be examined superficially.

The surgical rooms should be free from dust, smoke, and grime while the medical room, where the doctor has to examine hearts, should be as free of noise as possible. The building itself shall also have to be erected with reference to water, power, sewage, and cleaning.

NOMENCLATURE

A dispensary is a place where drugs are given out to patients. Usually the drugs are compounded in the dispensary and, as a rule, it is also the place where the doctor prescribes the remedy. Hence the same place is indiscriminately called the dispensary, doctor's office, hospital, and so forth. The dispensary is part of the medical department where medical, as distinguished from surgical, treatment is given.

A first-aid room is, as the name indicates, a place where surgical first-aid is given. It is usually a subsidiary part of the hospital proper which includes the medical as well as the surgical sections. The room in the hospital where surgical dressings and redressings are done is the surgery room, as distinguished from the first-aid room, which may be elsewhere in the plant. The latter may also be called the surgical or first-aid station. It is hardly permissible to call either a "clinic," though the term is often used. It is desirable, though not essential, to call the various activities of the medical department by their correct names and the time to do so is at the beginning; it makes the education of the employees easier. It has been suggested that employees used a place more freely when it was called a first-aid room than when it was called a hospital. It is best to name each place according to its major activity in order to avoid misunderstandings. "First-aid" is a simple term universally understood. "Clinic" has been used in another sense for centuries.

CONSTRUCTION

In the construction of a plant hospital only one rule need be kept steadily in mind; whether large or small it should be built with as much attention to heating, lighting, ventilation, plumbing, water supply, and painting as is given to similar up-to-date hospital work. Its attractive appearance, externally and internally, is a considerable factor in its success. If it is well designed and conspicuous the employees come to know of its existence readily and are apt to go there more freely than they otherwise would.

The following details, adapted from the specifications of the emergency hospital of the Clairton Works, Carnegie Steel Company, give ideas which may be applied to most hospital units, in plants with 1,500 employees.

Building:

Size, 46 feet 3 inches by 32 feet 9 inches, outside measurement.

Foundation:

Concrete—Concrete basement floor, 4 inches thick, inclined to floor traps.

Floors:

Italian marble terazzo in waiting, redressing, operating, and bath rooms. Maple, waxed and polished, in nurse's room, and ward. Terazzo floors have a floor trap and are inclined to trap for drainage. All terazzo floors have a 3-inch cove. There is a valve above the floor and against the wall for flushing with either hot or cold water and a hose bib for cleaning floors.

WALLS:

Operating and redressing room walls are tiled to 5½ feet. The remainder of walls and ceiling are enameled with zinc white and all corners are rounded.

Windows:

Double sash windows, 30-inch by 38-inch glass.

Doors:

All double doors 7 feet by 2 feet; single doors 7 feet by 3 feet; core locked and plain surface.

Painting:

All interior woodwork, walls, and ceilings may be finished with white or tinted zinc enamel.

VENTILATION:

Each room is provided with a Number 0 Sirocco blower with outside filter.

HEATING:

Hot-water heating with thermostatic control.

Water heating:

Instantaneous automatic water heater, capacity of 6 gallons per minute to 70 degrees F.

LIGHTING:

Combination gas and electricity fixtures of hospital design. Baseboard plugs in each room.

PLUMBING:

Operating room:

Porcelain-seat bath with gooseneck and removable spray; hot and cold water, foot control. Brass piping, rough finished and enameled. Porcelain wash-stand; roll-rim surgeon's wash-up sink, porcelain legs. Gooseneck removable spray. Knee-action supply valves. One autoclave. Instrument sterilizer.

Redressing room:

Porcelain-seat bath. Wash-stand. Electric sterilizer; water sterilizer. Slop sink, 22-inch by 20-inch by 12-inch, brass strainer, bronze trap, compression faucets.

Bathroom:

An enameled iron roll-rim, bathtub 6 feet 6 inches; white-enameled outside, quick opening valves, automatic regulator; canvas hammock and air pillow. A water-closet with impervious seat, high up pull flushing tank. Rough-finished enameled brass fixtures.

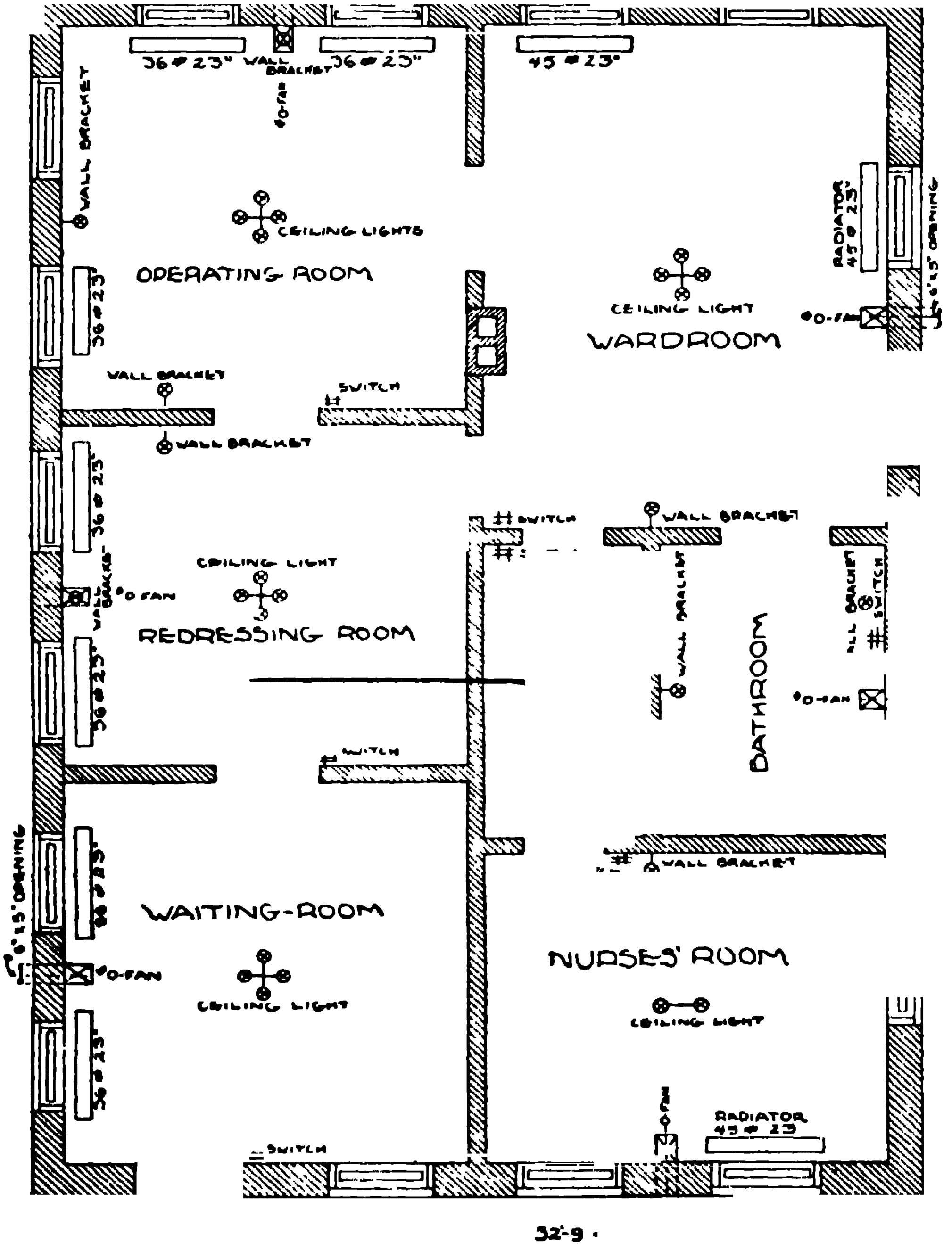


Figure 3: Plan of standard emergency hospital

The plan shown on the opposite page shows the layout of the emergency hospital detailed above.

PLAN OF STANDARD EMERGENCY HOSPITAL

Waiting-room. Although a waiting-room should be provided, there should be as little time lost in waiting as possible. The doctor should not have to wait for patients any more than a crowd of patients should have to wait for the doctor. In a plant with 1,500 workers about 15 workers may be expected to attend on the average in a day and hardly more than 5 or 6 at any one time. The room should be plain though not unattractive. There should be a table with at least six white-enameled chairs. A corner of the room may be used for a locker which contains crutches, blankets, and stretchers for emergencies, and a bulletin-board is useful on the wall for giving information about the routine of the medical department.

Redressing or first-aid room. Next to the waiting-room is the first-aid or redressing room, equipped with one or two surgical units arranged on line between entrance and exit. This unit is placed for maximum convenience of nurse and patient as is seen in the diagram reproduced in Figure 9, page 264. It consists of a glass-top dressing table alongside of which are chairs for nurse and patient with a foot-rest between them and an arm-rest for hand cases. On the left side of the nurse's chair is a wash-bowl, on the other side of which the unit is repeated if necessary. The patient faces the light which is at the back of the operator, and between the windows are glass shelves set into the wall to the depth of four or six inches and graduated in size to accommodate the larger solution bottles. Under the shelving is a cabinet for dressings and instruments. In places where there is no operating room, space is provided for an operating table which can be screened off from the rest of the room at will and an extra wash-bowl is provided for the doctor and nurse. In some cases a foot-bath is provided alongside the dressing unit with a chair on each side for foot and leg injuries. Provision is made for sterilizing instruments after each patient, and several pails are used for discarded dressings and bandages. Unless otherwise provided for there is a desk to be used by the nurse in making records of cases.

Operating room. This room has, besides the equipment mentioned in the first-aid room, complete facilities for sterilizing bandages, instruments, and dressings and an operating table. It has a wash-stand with knee-action supply valves and is used for minor operations and emergency surgical work in severe cases. It should be kept clean in the surgical sense.

Ward- or rest-room. This room is equipped with two or three beds of simple design and there is a table with one or two chairs, and hangers for clothing. It is used in cases of sudden collapse from heat, shock, gas poisoning. The beds are supplied with warmers. The room may be used for cases of temporary indisposition and for resting after minor operations or before removal to the hospital.

Bathroom. In steel mills a bathroom is found to be useful in cases of heat stroke and heat exhaustion. It has an automatic water-mixer and is provided with a head-rest,

Nurse's room. This may be used as a bed and sitting room for the nurse when not engaged in the attendance on patients.

X-ray room. Where fractures are not uncommon an x-ray equipment is very useful. Previous experience in the character of accidents determines whether an x-ray equipment is necessary. In isolated large plants it is, of course, a necessity.

Storeroom. Some storage space is found to be necessary for medical and surgical supplies and equipment. When a special room cannot be provided a large locker in the rest-room may be used.

Laboratory. In those plants where medical service aims to be comprehensive it is desirable to provide some laboratory facilities for the examination of blood, sputum, and urine. In small plants the physical-examination room can be adapted to the purpose at times when physical examinations are not taking place.

HOSPITAL EQUIPMENT AND SUPPLIES

The hospital equipment should not be purchased until a definite plan, founded on a thorough survey, has been thought out. A doctor can then easily decide what he requires, always remembering that room must be left for expansion and that it is better to buy a minimum at first and grow than to load up the hospital with useless equipment. While the doctor should have his choice of equipment he should be able to give an intelligent reason for ordering each piece. By this means there will be little chance of buying what is not actually wanted.

It is false economy not to buy the best quality of articles which are in frequent use. Care must be taken to avoid securing material which is needed only a few times a year or which, better still, can be availed of elsewhere. In ordering each piece, the object of its use should be kept clearly in mind and it should be noted that an adjacent hospital often renders the need for x-ray apparatus, for instance, unnecessary. The experience of long established medical departments is useful in checking up against the proposed equipment, provided they are about the same size and in the same line of work. Most plants have much information as to what purchases should be avoided. No furniture should be ordered until a place has been assigned to it in scale on the floor plan. Furniture and equipment mapped out in this way shows the arrangement, accessibility, and availability of space.

EQUIPMENT LIST SUGGESTED BY THE LIBERTY MUTUAL INSURANCE COMPANY FOR THE NEEDS OF THE PLANT HOSPITAL

FURNITURE

One operating table
White desk and chair
One examination table
Dressing table
Small metal-top table
Two-basin stand and basins
Two metal chairs, white
Four cans for sterile goods
Four instrument trays
Electric sterilizer
Sterilizer table
Two dressing trays
One covered waste pail
Foot-tub
Hospital cot and mattress
Six assorted basins
Six sheets
Feather pillow
Rubber-covered pillow
Four pillow-cases
Two pair of blankets
Twelve towels

INSTRUMENTS

Two pairs of crutches
Three bundles splint wood
One razor
Bandage scissors
Four pairs hemosthats
Two scalpels
One plaster knife
Catheter
Six slings
Four nail brushes
Six Number 1 catgut sutures
Six chromic catgut sutures
Horsehair and silkworm sutures
Six silk sutures in tubes
Six skin needles
Two lunar caustic sticks
Two clinical thermometers
Two pair scissors
Smooth forceps
Tooth forceps
Director
Probe
Bone cutter
Tourniquet
Three drinking glasses
Hypodermic syringe and morphine
Three pairs rubber gloves
Six finger splints
Small magnifying glass
Splint saw
Measuring glass

SURGICAL AND MEDICAL SUPPLIES

Iodine solution 3%, 4 ounces
Aromatic ammonia, 4 ounces
Boric ointment
Collodion, 2 ounces
Boric acid solution, 10 ounces
Olive oil, 4 ounces
Carron oil, 1 pint
Cocaine hydrochloride
Aspirin tablets, 100 5-grain
Mahady Dusting Powder
Plaster bandages, 6 4-inch
Camphorated oil ampoules
Cotton wadding, 24 sheets
Talcum powder, 2 ounces
Zinc oxid adhesive plaster
Alcohol, 70%, 1 pint
Ether, 4 4-ounce cans
Isarol ointment, 4 ounces
Argyrol solution 10%, 2 ounces
Chloroform liniment, 4 bottles
Ambrine, 1 pound
Six 4-inch flannel bandages
Absorbent cotton, 1 pound
Sterile gauze, 25 yards
Throat sticks, 1,000
Applicators, 2 gross
Gauze bandages, 25 1-inch
Gauze bandages, 25 2-inch
Gauze bandages, 25 3-inch
Gauze bandages, 20 4-inch
Gauze bandages, 15 1½-inch
Gauze bandages, 15 2½-inch
Bicarbonate of soda, 1 pound
Medicine droppers, 6
Leather finger cots, 6

Equipment should be purchased in units which, if satisfactory, can be duplicated without difficulty. Ordinary rather than special types of apparatus cost less and are apt to be more useful; the plant hospital is no place to experiment on equipment. Simple designs are less expensive and easier to keep clean.

EQUIPMENT LISTS

The Liberty Mutual Insurance Company uses and recommends, for the needs of the plant hospital, the furniture, instruments, and surgical and medical supplies listed on the opposite page.

FORMS AND RECORDS

"No factory management, employees' organization, or public health agency can control or prevent sickness without knowing when, where, and under what condition sickness actually occurs." This is the dictum of the United States Public Health Service and it is correct. The criterion of a well-run medical department is that it has adequate records of its work. One which has insufficient records is working in the dark. Plant managers who insist on full records of accomplishment from each operating department often neglect to get similar reports from the doctor. Hence the progress of the medical department is slow; the plant manager does not know the volume of work being done and the doctor, himself, is unable to proceed intelligently.

Some medical departments procure all the necessary statistics but they are buried away and never collected. They are only one degree better than those who make no effort to keep any statistics. In the present state of our knowledge no doctor should fail to collect and compile medical and surgical records. We lack full knowledge of the incidence and extent of industrial sickness. It is only by the statistical analysis of plant experience that sound conclusions may be reached. The doctor should not, however, collect any more information than can be digested, compiled, and used.

The foundation of a satisfactory statistical compilation of medical information is the character of the forms used to gather the information from each individual. All medical department forms should be prepared with the idea that they will be eventually used for the purpose of making a complete record of the work done. The individual form makes the daily total, the daily results make the weekly total, and so on, till the annual statistical report is prepared. Unless the forms are designed with the above eventual purpose in view much needless clerical work will result. Hence, information common to all reports should have the same sequence on each form; there should be duplication or triplication whenever necessary and different colors may be used to facilitate sorting of the forms, to distinguish between medical and surgical, male or female, white or colored workers, or between severe and mild cases.

The purpose of securing facts is to record the findings, to give an accounting of what has been accomplished, to determine on and improve methods, to throw light on the problem of disease prevention and to detect and measure health hazards.

In 1920 the United States Public Health Service made a plea for more complete records of sickness in industrial establishments and suggested that unless sickness is expressed in the form of a rate there is no possibility of determining increase or decrease of sickness or of comparing the figures in one plant with those of another. In order, therefore, to express sickness in terms of rates per thousand employees the following records are necessary:

1. The number of persons for whom sickness records are kept, whether they are actually sick or not, during a given period. Care must be taken to distinguish between

the number of persons at work and the "number on the pay-roll." The sickness rate is calculated on the basis of all employees.

2. The number of cases of sickness occurring among these people during the same period.

There should also be a record of:

1. Age, sex, occupation, and department of each person in the plant and of each case of sickness.
2. The cause of sickness as diagnosed by a physician.
3. The number of days lost for each sickness.

With such information the normal expectancy of sickness, the occurrence of various diseases, of different sexes, ages, and conditions, the amount of preventable illness, the effect of certain hazards, and the improvement in conditions may be obtained. In addition, by the rendering of a monthly statistical report the plant manager is enabled to keep in touch with the progress of the medical department and to determine whether increased medical supplies or facilities are necessary.

In the preparation of statistics certain standard codes may be used. The United States Census Bureau has a standard list of industries and of occupations and a standard nomenclature of diseases. In the case of death the *International list of Causes of Death* may be used. On page 169 of the *Monthly Labor Review*, of the United States Department of Labor, for February, 1925, will be found a "List of Diseases and Pathological Conditions for Industrial Morbidity Statistics," which should be used in the compilation of plant sickness records. By means of these, comparison with the records in other plants becomes a possibility.

It is obvious that no doctor should have to make compilations of records himself. This is the duty of the clerk or the nurse acting under the directions of the doctor. It is the latter's function to diagnose and record the diseases, to direct the compilation of the records, to interpret the findings, and to apply the necessary preventive measures.

SOME TYPICAL PLANT HOSPITALS

The Norton Company, Worcester, Massachusetts. The medical department of the Norton Company was started in 1911 to increase efficiency and to create good-will. It is, perhaps, one of the best medical departments in the country. Unlike most concerns there is, strangely enough, no physical examination for three weeks after hiring and a very genuine effort is made to remedy defects rather than lose an employee. The factory physician has regular office hours morning and afternoon for sick workers, and the aim is prevention. Patients who are too sick to work are sent home and told to see their family physician. The factory doctor does not call at the home of any employee. The foremen are given sound first-aid instruction. In accident work workmen are given prompt treatment and then conveyed to the hospital. Every department is fully equipped with first-aid outfits.

Owing to the large area covered by the plant there is a central hospital in charge of a full-time doctor, and two subsidiary hospitals each in charge of a nurse. The plant has 2,500 employees, "The cases treated at the plant hospital run at the rate of, males, 2,644 per thousand," with about 130 visits per day.[1]

The doctor is head of the Sanitation Department and is responsible for the maintenance of sanitary conditions in the shop. Much effective health publicity is carried on.

Thomas A. Edison Interests, Orange, New Jersey. The Health Department of the Edison Company is concerned with sickness, accidents, occupational diseases, sanitation, and health education. The hospital is equipped for major operations and is open during working hours. The prevention and cure of sickness is rapidly increasing in importance, and health education is an important feature in the training of employees.

---

[1] Clark, W. Irving. "What a Medical Department in Industry Actually Does," *Industrial Doctor,* June, 1924, p. 90.

The Orange hospital consists of the doctor's office, laboratory, waiting-room, safety museum, stockroom, dark room, x-ray, dormitory with two beds, and the operating room. A doctor and three nurses comprise the medical staff. First-aid men in the plant are supplied with the necessary equipment and instructed in its use.

Western Electric Company, Hawthorne Works. This company, with 35,000 employees, has one of the largest plant hospitals in the country and provides hospital quarters for patients undergoing major operations. There are facilities for dealing with communicable disease, provisions for 1,500 physical examinations a week, and a full x-ray equipment. The medical facilities are open day and night and bilingual doctors attend to the wants of patients. All applicants undergo physical examination.

R. K. LeBlond Machine Tool Company. The hospital department consists of nine rooms, a waiting-room, a first-aid room, a laboratory, an operating room, an office, a dental room, a dark room for eyes, a bedroom, and a sterilizer room. The hospital takes care of medical as well as surgical cases. During 1919 there were 15,183 patients treated; 4,285 surgical conditions; 5,136 medical conditions; 1,064 redressings; 3,192 retreatments, and 1,506 dental cases. Safety, sanitation, and health are supervised by the medical department.

National Cash Register Company. The medical staff of the National Cash Register Company consists of three doctors, one dentist, three nurses, two treatment-room men for physiotherapy, one masseuse, and three clerks. In 1922, 3,895 applicants were examined and 104 rejected; 794 were examined for transfer; 15,409 received examinations, treatments, consultations, and vaccinations; 3,199 visiting-nurse calls were made, 26,648 other cases, including injuries, surgical dressings, and x-rays; 8,033 physiotherapy treatments were given and there were 9,303 dental cases, a total of nearly 51,000.

The National Cash Register Company specializes in health education which begins with the applicant, who is given a health and safety lecture in the first hour of his employment. All get a health rating every six months. Persons found underweight are sent to the medical department for treatment. Foremen get a medical report of the department each month and bulletins, pamphlets, and lectures are also a feature in health education.

Visiting nurses call daily on the employees and give advice and attention. Cooperation of city physicians is sought and children of employees are given health education.

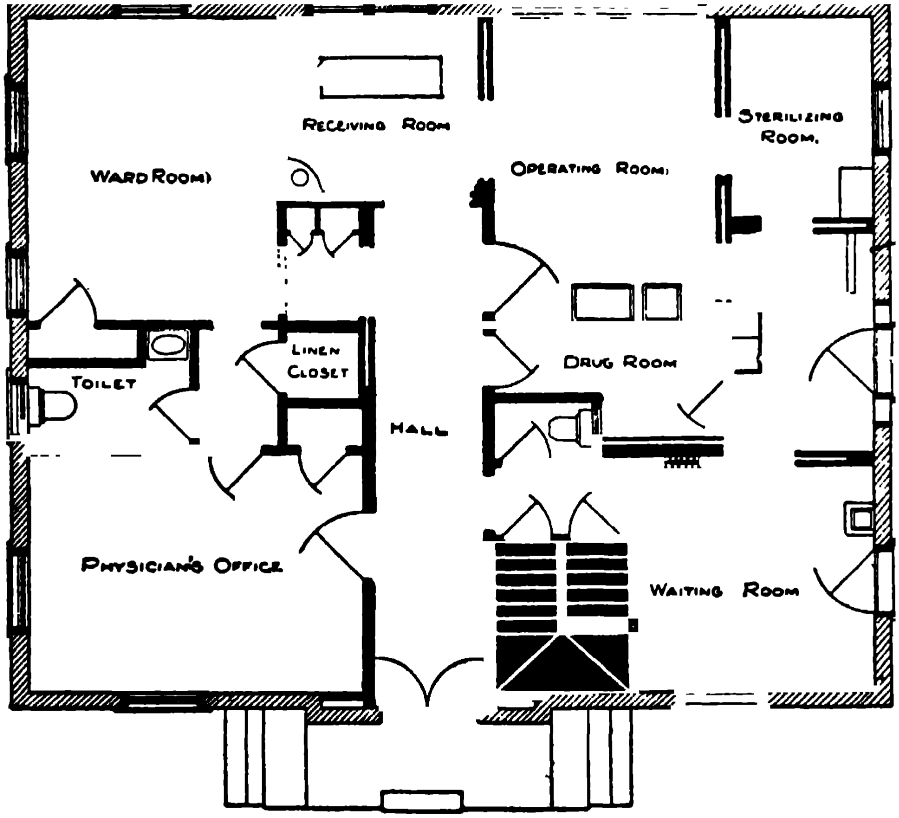


Figure 4: Emergency hospital of the American Rolling Mill Company, Middletown, Ohio

American Rolling Mill Company. The Armco medical service consists of a main hospital, dispensary, shop dispensary, treatment room, physical-examination room, and ambulance stations with motor equipment. The main hospital consists of waiting, dressing, sterilizing, and dispensary rooms, office, kitchen, dining rooms, and living rooms for matron. There is an operating room, ward, laboratory, and x-ray room. The dispensary consists of waiting-room, consultation room, and dispensary for the emergency care of sick and injured.

The personnel consists of three full-time physicians, six graduate female nurses, five experienced male nurses, three clerks, a matron, and two janitors. The medical service for minor sicknesses is free to employees but does not extend to their families. The physicians make regular inspections for sanitary conditions and undertake the health education of the workers by systematic talks.

Winchester Repeating Arms Company. The medical department covers general hospital work, hygiene and sanitation, health education, consultation and advisory work. The company had, in 1920, about 8,500 employees and had 54,869 cases; 13,456 dressings; 28,986 redressings; 10,091 cases of sickness; 121 x-ray cases; 213 physical examinations.

Emergency treatment is given in case of sickness and the patient is referred to his family physician or specialist in case of need. Cases involving local anesthesia are handled in the plant; general anesthesia cases are handled at the local hospital with the plant doctor operating or in attendance. Physical examinations are made with the aim of placing a worker suitably.

International Harvester Company. The medical department has a surgical, physical examination, and laboratory unit.

Continental Motors Corporation, Muskegon Plant. This company, with 4,200 employees, treated in a recent year 11,041 injuries, had 12,209 redressings, a total of 23,250 treatments. The department is in charge of a physician, two graduate nurses, and a clerk. All new employees are given a physical examination.

Endicott-Johnson Company. This organization, with 17,000 employees, has three complete hospitals with surgical, medical, and maternity departments. The staff consists of twenty-seven full-time physicians, including one general surgeon, one refractionist, two nose and throat specialists, one pediatrician, three full-time dentists, two pharmacists, one masseur, one x-ray operator, and fifty-one nurses with the necessary clerical attendants. The hospitals are managed by a director who also supervises all welfare work and money expenditures.

All workers are physically examined before hiring and at the end of six months, if found sound, they are permitted to join a mutual sick relief association at a cost of 20 cents a week. Staff doctors are in attendance at the medical centers from 8 a.m. to 7 p.m. with a trained nurse and clerical assistance. An ambulance service, for use of medical, surgical, or maternity cases, is used for about 5,000 cases a year.

Surgical appliances are supplied free of charge and medicine is dispensed without cost. If special treatment is required the patient is instructed accordingly. Each office has a dental department and there is a central x-ray outfit. The eye specialists have an office for refraction and treatment. The staff doctors made 75,000 visits to the homes of workers and the visiting nurses made 15,000 calls in a year.

Colorado Fuel and Iron Company. The Steel Works Dispensary of the Colorado Fuel and Iron Company reported, for the year ending June 30, 1924, the number of surgical cases and medical treatments or examinations, and so forth, listed on the opposite page.

Surgical

"First-aid" (original injuries)	6,853
Subsequent dressings for above injuries	10,780
Vaccinations	222
Total	17,855

Medical

Individuals presenting themselves for treatment	26,215
Prescriptions filled for above patients	(35,335)
Physical examination for employment	3,462
Visits at homes	2,704
Total	32,381

HEALTH MAINTENANCE IN INDUSTRY

PART II

THE MEDICAL DEPARTMENT

VII

MEDICAL SERVICE

Medical first-aid. Increase in popularity. Equipment and layout of dispensary. Bottles and shelves. Dispensing medicine in the plant. Medical duties; prevention and cure. Preventive methods. Health education. Publicity methods. Health literature. "Health Hints."

MEDICAL treatment is now becoming a more important factor than surgical treatment in our plant hospitals and it is only a matter of time when plant surgery will have a minor place. This means that a change of attitude in the operation of industrial medical departments is now in order. Any new project should be considered with the idea of providing better accommodations for medical work. The first-aid room or the physical-examination room is often used for consultations, since medical work has only been introduced as an afterthought. The special need in consultation is privacy and it cannot usually be secured in the first-aid room; the proper place is a private room. In the smaller plants the physical-examination room, or one adjoining it, can be used and it can also serve the purpose of an office for the doctor.

The reason for having a separate, quiet room is to enable the doctor to give his undivided attention to each case and, also, to create the conditions under which patients will talk freely. Here the doctor makes his diagnosis and gains the confidence and good-will of the employees. People are naturally secretive about their ailments and the presence of others hinders them from telling all the doctor ought to know. The current evolution from surgical to medical work results from the fact that accident work is now becoming systematized; it is relatively less important than medical work in point of time saved and, besides, the time is coming when state health medicine may be forestalled if not headed off by efficient plant medicine.

In comparatively few plants there will always be need for more surgical than medical work, but in the large majority of cases it will be found that sick employees are more numerous and lose far more time than those who have been injured. In the machine trades, for instance, at the present time surgical cases are six or seven times the number of medical cases. The reason is not that medical cases do not exist but that no medical treatment is, as yet, given in some of the plants. In the lighter trades the number of surgical cases is much less. A large telephone company, having little plant work and many female workers, has three times as much medical as surgical work, but this is exceptional. The amount of medical work done is no indication of the amount that could be done if full medical service were supplied.

The medical activities of a plant may be divided into two main fields: prevention and cure. The aim is not only to secure immunity from disease but to cure it as promptly as possible and, hence, the two activities run concurrently. The work is, in fact, medical first-aid, just as there is surgical first-aid, and the medical department is really a clearing-house for all cases that come to it. The patient is given treatment of a strictly temporary or routine nature and is then either allowed a brief period of rest, returned to work, sent home or to a specialist when necessary.

THE DISPENSARY

It is impossible to give proper medical first-aid unless the necessary equipment and facilities are provided. The surgical first-aid room cannot be properly used for the purpose except in very small plants. There must usually be a place where not only the doctor can prescribe medicine but, also, where the prescription can be filled. In the very large plants a pharmacist will have to be employed and, as in the Endicott-Johnson Company, any medicine needed is dispensed without charge. The John B. Stetson Company has had a pharmacy for many years and fills prescriptions at a nominal charge. Such cases are, as yet, exceptional. The general practice still is to meet emergencies by administering some simple remedy and there is no formal compounding of medicines.

In the smaller plants there are three alternatives: prescriptions may be sent out to a neighboring drug-store to be compounded, a pharmacist may be employed on part time, or the doctor may make up the medicine himself or have it made by an assistant. The latter plan is economical and immediate, particularly if the doctor limits his range of drugs and has the stock medicines made up in slack periods. The nurse may compound drugs under the doctor's immediate supervision and dispense them, but she must not prescribe medicine no matter how simple or obvious the remedy.

When the doctor has to compound his own medicines he is apt to be perfunctory and this creates an unfavorable impression on the patient. Compounding medicine is really not the doctor's function at all, but if circumstances make it advisable he should be particular as to the character, quality, appearance, and manner of dispensing.

Most cases of sickness in the plant, as we know, are due to a narrow range of minor ailments and, by having some routine method of treatment, the necessary drugs can be compounded beforehand at a minimum cost. The common cold, for instance, occurs very often in industry. It would be easy to provide an effective routine method of treatment.

The dispensary, then, is a place, broadly speaking, where patients are examined, diseases diagnosed, remedies prescribed, compounded, dispensed, and consumed or taken home, either to relieve minor ailments or to nip incipient sickness. The doctor is in attendance all the time or at stated hours according to the need of the patients.

The equipment of a plant dispensary is simple. There must be shelving, lockers, and bottles for the drugs. The size of the room will depend largely on the amount of wall space needed for the shelving, and the smaller the better. The shelving should be enameled steel rather than wood in order to economize space and to facilitate cleaning. A common mistake is to make the shelving much too deep; it need only be deep enough to accommodate the bottles comfortably and it should be graduated in depth so as to hold bottles of various sizes. A series of lockers, 4½ feet in height, should support the shelving which should rise to about a height of 7½ feet with shelves at 12-, 9-, 8-, and 7-inch intervals, narrowing as the height increases. The length and depth of the shelving will be determined by the number and sizes of the bottles in use. The shelving is divided into bays about 20 inches wide. In the larger pharmacies the shelving may extend to the ceiling, in which case a sliding ladder will be needed.

The bottles should be glass-stoppered; they and the jars should have glass-inset labels and they should be arranged alphabetically, each having a fixed and invariable position on the shelves. These bottles are for the material in immediate use; the lockers are for the supplies kept on hand.

Each doctor will have his own ideas as to what drugs should be supplied to a dispensary. The list on the opposite page is indicative of those suitable for a medium-sized dispensary. In a small place half the quantities given on this list may be ordered, the list being revised by the doctor. Simple solutions may easily be made up in most dispensaries. It is a great waste of money, for instance, to order boric acid solution from the druggist when it can be made fresh on the premises, when needed, with very little effort. It is not uncommon to find doctors ordering bichloride, picric acid, and other solutions when they could be made up very easily in the dispensary, at a tenth of the cost. If a pharmacist attends at the dispensary at certain times it is his duty to make up such solutions.

List of Drugs Suitable for a Medium-Sized Dispensary

32-ounce narrow-neck bottles

- Arnica Tincture
- Lead and Opium
- Boric Acid Solution
- Bichloride Solution 1-1000
- Chloroform Liniment
- Picric Acid Solution, 5%
- Carbolic Acid Solution, 5%
- Aromatic Ammonia
- Alcohol

32-ounce wide-mouth bottles

- Olive Oil
- Carron Oil
- Phosphate of Soda
- Epsom Salts

16-ounce narrow-neck bottles

- Hydrogen Peroxide (actinic)
- Sp. Ether Co
- Tincture of Ginger
- Tinct. Opii Co
- Iodine Solution, 10%
- Ethereal Soap

8-ounce white pots

- Antiphlogistine
- Unguentine
- Boric Ointment
- Petroleum Jelly

4-ounce white pots

- Iodoform Ointment
- Carbolated Petroleum
- Ichthyol Ointment
- Orthoform Ointment
- Zinc Ointment

MEDICAL DUTIES

The duties of the medical department, preventive and curative, may be summarized as follows:

1. Disease
    - (*a*) Examination to detect:
        - (1) Physical disability
        - (2) Occupational diseases
    - (*b*) Prevention of sickness in plant by:
        - (1) Individual advice
        - (2) Prophylactic treatment
    - (*c*) Prevention and control of communicable disease
    - (*d*) Care of the sick and treatment of minor ailments
2. Physical examination
    - (*a*) Applicants at entrance
    - (*b*) Reexamination
    - (*c*) Placement of men at suitable work
    - (*d*) Advice to those with impairments
    - (*e*) Supervision and follow-up
3. Health education
    - (*a*) Employees
    - (*b*) Families of employees

4. Administrative .
    - (*a*) Maintenance of records
    - (*b*) Control of medical staff
    - (*c*) Superintendence of mutual aid, insurance, pensions
    - (*d*) Inspection of work places

Although prevention is of profound importance it is difficult to draw a distinction between it and cure. Nevertheless, a doctor who recognizes cure as his only function is only partly successful although every cure is a prevention of further trouble.

METHODS OF PREVENTION

Health education. The plant physician will find a systematic health campaign of education necessary to prevent disease. The doctor is called on to act as a teacher of health principles, an activity which has not hitherto occupied his thoughts. Hence he is often found avoiding the issue or only tackling it in a half-hearted way. Health education is, perhaps, as important as any function the doctor has. It is a special branch of work which needs careful organization and an unwearying reiteration to be successful. Unless the methods adopted are founded on actual sickness experience in the plant, on a knowledge of the character, sex, habits, and proclivities of the worker, they can hardly be successful. It is no use preaching to men how to avoid goitre in places where there is none or in lecturing uneducated foreigners in English when they do not understand it, or in using technical language to the average worker. Whatever plan is adopted must be severely plain and practical. "Health education," as Dr. C. D. Selby says, "is exceedingly capable of reducing lost time and increasing efficiency among industrial workers," but a doctor who does not adopt it as a deliberate, always available, ever-present issue will fail.

Opinion is divided as to whether training in health matters should be individual or general. In industrial medical work it should be both. Most patients suffer from disease through lack of preventive measures. Every patient who goes to the plant hospital whether for treatment or for physical examination is in a receptive mood and should receive some ideas on prevention appropriate to his case. Health education of this kind costs practically nothing, yet it is important. As many employees go to the medical department in the course of the year, a considerable number is thus covered. Individual health education, of a subjective kind, costs money and is less impressive.

In addition to the individual method there must be some plan of general health education in order to reach those who fortunately do not have to go to the medical department. This is carried out by many agencies, the principal one being the group meeting, for workers, foremen, and department heads attend. As a background for general health education there must be some idea of the educative process, a differentiation between education and instruction, and an appreciation that the mere establishment of rules without a statement of the underlying reason brings small returns. There must be a thorough knowledge of the disabilities which workers show in the physical examination based on an analysis of the causes rather than on the impressions gained.

For educative purposes one has to consider the proportion of literate and illiterate, male and female, skilled and unskilled, to each of which a different appeal must be made. Literates can be educated through the mind, illiterates only through the eye. The National Cash Register Company has a scheme of health education for men and women, for employees' children and wives, and for new employees.

A thousand working women were examined in a plant and showed the following ailments:

Headaches	59.6%
Indigestion	40.0%
Constipation	43.5%
Menstrual disturbances	50.6%

With information of this sort it would be easy to make a suitable plan of health education for such a group.

Scope of subjects. The subjects discussed with employees must vary with the circumstances, differing in winter and summer, in epidemic and other outbreaks. At the National Lamp Works of the General Electric Company, lectures on health preservation are introduced by a general discussion on the necessity for good health as a means of maintaining continuous earnings. The employee is told of the employer's aim to preserve the health of the workers and how he proposes to do it, and the employee is asked to cooperate. The subjects are as follows:

1. *Food.* Varieties, tissue-building, heat, energy, fruit, overeating, auto-intoxication
2. *Air and water.* Necessity of water, amount per day; with meals, in beverages, tea, coffee, milk; water-borne diseases
3. *Exercise.* In relation to fatigue, accident, occupation; during working hours; excessive exercise; home exercise; effect on heart, skin, digestive apparatus
4. *Teeth, mouth, jaws.* Disease in the mouth, cause of other diseases; rheumatism, tonsillitis, abscess of jaw
5. *Colds.* Contagiousness; exposure; drafts and other modes of contracting; avoidance, outdoor sleeping, night air, treatment; adenoids and tonsils
6. *Home.* Tuberculosis and other chronic diseases; children, play, teeth, clothing, food
7. *Eyes, ears, and feet.* Eyestrain; light; astigmatism; common optical defects; earache, deafness, wax; flatfeet, corns, bunions, nails
8. *Medical and surgical emergencies.* Fainting; causes, stages, treatment; unconsciousness from other causes; headaches, toothache, nosebleed; sprains, fractures, dressings, dislocations, wounds, hemorrhages
9. *Goitre.* Causes, type, treatment; personal hygiene
10. *Alcohol and tobacco.* A stimulant? Effects; nicotine in smoke; cigar, cigaret, and pipe; effect on pulse and blood.

11. *Venereal diseases.* Various types; effect on individual, wife, and children; treatment

The Committee on Unskilled Labor and Americanization of the National Association for Corporation Training, in June, 1920, recommended the following subjects for foreign-born employees:

HEALTH

Milk and ice for infants and anaemic children
Sick adults
Care of babies
Prenatal care
Home visiting
Cleanliness
Ventilation
Personal hygiene
Pure food
Overcrowding

SANITATION

Garbage removal
Clean yards and alleys
Water
Drainage

METHODS OF HEALTH EDUCATION

Health education may be developed through the medium of the doctor, the nurse, or the foreman with the individual or the group, by oral or visual means. The foreman, of course, must be trained before he can be expected to help.

In oral methods there are talks and lectures. "Talks have done more, perhaps, than any single thing to sell to the employees the value of the medical department in our plant," says Dr. Elliott, and the same remark applies to education. Talks may be inspirational or educational, sometimes one, sometimes the other. Sometimes these talks are informal to a fault. They have spontaneity but lack form. Time is too precious not to merit complete preparation and, at least, the doctor should make careful note of what he intends to say. It is better, however, to prepare the whole subject and commit it to writing, weighing every word and eliminating those which may be misunderstood. When addressing the whole organization in a group an inspirational talk is possibly the best. Later the doctor can take groups of about 25 employees until the whole organization has been covered. In such talks the subject is specific, having previously been prepared, and the address is made partly on company time. In order not to interfere unduly with production it is better to have a few men from each department rather than all from one department. If the lecturer is in touch with the production department he can ascertain what time can be devoted to health education that will not interfere with the work. Workers are encouraged to put questions to the lecturer, who answers them at the end of the talk either individually or for the benefit of all. In some places members of employees' families are invited to hear health talks, and at least employees are encouraged to discuss the subject at home.

Talking machines and radios are now available for health talks and may be used to advantage. Some of the larger railroad companies have already used the radio for communicating with their employees and health education may easily be included in such a plan.

Visual methods are numerous. The National Cash Register Company has a series of motion picture films for disseminating health education. These pictures may be used to illustrate talks and can be made to cover a wide range of subjects. It has been found that the best results are obtained when health subjects are introduced among those of general interest. Still life pictures may also be used.

The use of films in health education is increasing. The United States Public Health Service uses them as a means of educating the public and the demand exceeds the supply. The National Health Council has recently prepared and published a list of the films available for use. More than 300 titles are included in the list which gives the number of reels, length of film, name of distributer, cost, and subject. These films cover the subjects of child hygiene, personal hygiene, public hygiene, communicable disease, nursing, and other allied matters.

Publications suitable for distribution are now numerous and it only remains for the doctor to make a suitable selection. Usually it is better to adapt prepared material to the special needs of the plant, but some concerns have prepared their own health literature. The United States Public Health Service has issued a "Keep Well" series of pamphlets on "The Road to Health," "How to Avoid Tuberculosis," "Flat Foot and other Foot Troubles," and also a number of valuable reprints from the *Public Health Reports*. Among its miscellaneous publications are "Prevention of Disease and Care of the Sick," and "What to Do in Accidents," which should be distributed among those who are to take part in the process of education.

Many of the states publish health information, and numerous public and private agencies, such as the insurance companies, have issued many instructive articles. Bulletins which can be distributed by hand or which can be displayed on bulletin-boards are found to be of considerable value. The situation is complicated where foreign-born workers are concerned, but it is well known that pamphlets, in English, given to such workers are often taken home to be read by the children who are attending school and understand English. These bulletins educate the family as well as the parent. Some companies insert articles on health in the local foreign newspapers.

Cards, booklets, leaflets, and rules are issued systematically by some plants. "Health Hints," printed on a stiff card and distributed with the pay envelope, serve to stimulate interest. These are somewhat as follows:

> Walk to work if possible.
> Avoid the person who coughs or sneezes.
> Wash hands before eating.
> Make full use of available sunshine.
> Don't use common towel; it spreads disease.
> If you cough or sneeze, cover mouth with handkerchief.
> Keep out of crowded places.
> Sleep well, avoid overexertion; eat good, clean food.
> Keep away from people with influenza.
> See the doctor the minute you feel sickness coming on.

The Life Extension Institute issues a card with "The Sixteen Important Rules of Hygiene" which is typical:

1. Ventilate every room you occupy.
2. Wear light, loose, and porous clothes.
3. Seek out-of-door occupations and recreations.
4. Sleep out, if you can.
5. Breathe deeply.
6. Avoid overeating and underweight.
7. Eat sparingly of meats and eggs.
8. Eat some hard, some bulky, some raw food.
9. Eat slowly.
10. Drink sufficient water.
11. Evacuate thoroughly, regularly, and frequently.
12. Stand, sit, and walk erect.
13. Allow no poisons and infections to enter the body.
14. Keep the teeth, gums, and tongue clean.
15. Work, play, rest, and sleep in moderation.
16. Keep serene.

It reduces such rules to a farce if the employer has not made them possible of accomplishment. Either the rules must be made to conform to the plant practice or they must be altered. It would be absurd for an employer to tell the worker not to use the common towel if it is permitted in his wash-rooms. Yet such things are known to happen and are the danger of ready-made propaganda.

Another means in use is the exhibit, traveling or stationary. The Department of Public Health maintains a loan service in Illinois consisting of mechanical models, films, slides, wall panels, and posters designed to depict health principles. These models illustrate "The Fly Danger," "The Rat Menace," "The Priceless Gift of Health," and are sent to any community in the state at the cost of transportation. A less elaborate but effective method is to have exhibits in local stores where workers will be sure to see them. All these tend to educate the worker and help the doctor in his prevention campaign.

The Division of Industrial Hygiene of the New York City Health Department, for instance, issues a series of health posters for display on plant bulletin-boards which may be obtained from 505 Pearl Street, New York. These posters, 52 in number, cover the whole field of health education; many of them are suitable for any plant.

Attention must be paid to the contents, time, manner, period, and place of distribution. These details must be thoroughly organized in order to reach every employee. The handing out of leaflets just as employees are leaving the workrooms for lunch ensures them some attention. In the hurry of leaving the plant a leaflet is not unlikely cast aside. Those who distribute the literature should show by their manner that the leaflets are intended to be read. In any distribution it is desirable to plan ahead and to fix on a weekly distribution for several weeks. Bulletin-boards should be placed where employees can see them, that is, at the entrance to lunch rooms, near water founts and time clocks. If the frames are painted in bright colors, kept clean, and the contents changed frequently, men get the habit of looking at the boards to see what is there.

It is a good rule not to undertake the distribution of literature if it can be done effectively by some public agency. In some places the parish, the Red Cross, the Public Health, the schools or clubs may be prevailed upon to undertake the preparation and distribution of health literature, but if not they may be induced to make a wider distribution of literature prepared for plant purposes.

VIII

MENTAL HYGIENE

A need in selection. Attitude and production. Extent of abnormality in industry. The menace to harmony. Mental hygiene and mental defects. Types of abnormal workers. The subnormal; the psychoneurotic; the psychopath. Functions of the psychiatrist.

MANY industrial firms now have elaborate methods for selecting the worker. The employment manager, with the aid of job specifications, seeks to match the requirements of the job with the qualifications of the applicant; the doctor ascertains physical fitness and, not infrequently, there are tests to determine innate and acquired intelligence on entrance. In a few cases attempts are made to rate an employee's worth after he has been in employment for some time. So far, however, practically no organized effort has been made to ascertain the mental make-up of applicants or employees at entrance or subsequently. It is easier to test for a sound body than a sound mind, but it is not always more important, and the process of selection is incomplete as long as the question is ignored.

A worker's attitude towards his job determines his efficiency; he may be physically capable, experienced and skilled but his mental condition often prevents him from being a useful and steady producer. He may, indeed, be a positive detriment to a plant by his acts and by his baneful influence on others.

The lack of some method of determining mentality and of keeping or restoring workers to a normal frame of mind has been felt by all those who seek to maintain a happy and contented group of employees. There is, on this account, a rising interest in the scientific investigation of mental states. The science that concerns itself with the study of the mind is called "psychology." Psychology deals especially with the mental processes of normal individuals. A knowledge of the normal process of mental action enables an investigator to determine the mental condition of the applicant for work and to place him where he will be most useful.

The psychologist seeks to fathom the contents of the normal states of mind and to ascertain the quality of the mental apparatus. The psychiatrist investigates abnormal mental states, seeks to remove their cause and to secure mental health whereby the individual can be of most use to himself and others. Some irrational workers are found in every plant of any size, causing disturbance of a more or less serious character which destroys the harmony so necessary for production. Employers are often puzzled by irrational acts of old and faithful employees and do not understand that they are symptoms of mental derangement which may be very serious. Such temperamental difficulties and queer behavior may require the aid of a psychiatrist.[1]

Some people deny the existence of mental diseases in industrial life; others consider every striker, every malcontent as of unsound mind. Carleton Parker said that, "Modern labor unrest has a basis more psychopathological than psychological, and it seems accurate to describe modern industrialism as mentally insanitary." He considers that, "thwarting the instincts and condemning the worker to a life of limited happiness, restricting personal development, and desolation when sick, brings about a state of mind which amounts to an industrial psychosis." Statistics show the existence of madness and although many of the afflicted are confined in institutions yet all are not there. Fifty per cent of those admitted to institutions each year are discharged cured or improved and doubtless some of them get into the plants of the country. Those who take the view, however, that every discontented and complaining worker is mad may be in need of psychiatric aid themselves. Some workers strike because they are clear thinking enough to discern a just cause and to enforce it by drastic action. The fact that much irrational striking exists is yet another argument for giving more attention to psychiatry in industry. Not only that, but a man's mental condition is frequently a cause of inefficiency and it has been said that mental diseases far outweigh all other illness as a cause of human misery.

---

[1] See *Clinical Psychiatry*, by Diefendorf., p. 97, for method of examination, also, *Psychiatric-Neurologic Examination Methods*, August Wimmer, M.D., C. V. Mosby.

MENTAL HYGIENE AND MENTAL DEFECTS

The mental hygiene of industry has a rather wide scope. Its principal, and better known, activity is psychological, as in the testing of applicants and employees. Psychiatry is concerned with the exclusion or placement of the psychopathic or abnormal. It endeavors to seek out causes of grievances or dissatisfaction; to determine the reason for lack of efficiency, to study causes of turnover and discharge and to remove them or change the attitude of the employee. The psychiatrist seeks to prevent mental breakdowns by adapting the worker to his job and to his environment and thus eliminating possible causes of discontent. He treats each individual case of subnormal behavior as one of mental sickness and endeavors to restore persons so afflicted to normality.

At the beginning of 1923, it is announced by the Department of Commerce, 348,174 mentally diseased, feebleminded, and epileptic persons were confined in the various institutions of the United States. Dr. Pierce Bailey, in the *New York Times* of September 14, 1919, called attention to the wide-spread and varied character of mental defects among those called for army service during the Great War, and he classed the patients who passed through the hands of the neuro-psychiatric officer of the United States Army into the various groups listed in Table 15.

TABLE 15

CHARACTER OF MENTAL DEFECTS AMONG THOSE CALLED FOR ARMY SERVICE DURING THE GREAT WAR

Character of Defect	Number	Percentage
Psychoses or mental diseases	7,910	11.0
Epilepsy	6,388	9.0
Organic nervous diseases	6,918	10.0
Glandular disorders affecting growth	4,805	7.0
Neuroses or functional nervous diseases	11,443	17.0
Inebriety (alcohol and drugs)	3,878	6.0
Mental defects	21,858	31.0
Constitutional psychopathic state	6,196	9.0

These people, Dr. Bailey remarks, "were returned to the civil community," which means that many of them went back into industry. Of the last four groups, he says, "Every employer of labor . . . . is constantly encountering, to his dismay, individuals from these four classes, without recognizing them, or knowing what to do with or for them. Such persons are not only ineffective themselves but they make others ineffective. . . . They are sick persons, whose symptoms appear as abnormal behavior."

CLASSIFICATION

The abnormal worker in industry either lacks brains, has a brain of inferior quality or has a diseased brain. It is of vital importance to industry to distinguish between the normal and the abnormal, and between the different types of abnormality. Some of the latter are a menace to themselves, to their fellows, and to the plant; others are a trouble only when placed in unsuitable occupations. It is not easy to differentiate between types of mentally abnormal people; they may, however, be classed as:

1. *The mentally defective; the the sub-normal.* This person's mental age is lower than his physical age. Physically he may appear grown up; mentally he may be only 10 years of age. The futility of putting such a person at responsible work is bad for the job and possibly

worse for the individual. He is incapable of planning, reasoning or judgment and is made thoroughly unhappy at work beyond his capacity. "Properly assigned," says Dr. G. K. Pratt, "and in certain jobs the defective is a satisfactory and even valuable worker. . . . In those industries where automatic machinery largely predominates, such as in the automobile and, to a lesser extent, in textile plants, the subnormal individual is often sought out." Such persons can be taught somewhat complex industrial processes under direction. An experiment to determine the possibility of using girls of this type in factory work has been conducted in one of the large rubber companies. In peeling tomatoes for canning, the moron showed 68% efficiency as compared with normal women, according to an investigation made in 1919; and, New York State, since September, 1917, has been trying out industrial colonies of morons in preference to keeping them unoccupied. It has been found that, by nature, the moron is happiest when provided with agreeable and monotonous work.

One of the cardinal faults in some plants is that there is no scheme of promotion for the mentally alert and vigorous. It is an equally grave fault to assume that every employee is suitable for promotion. The employment manager who fails to distinguish between the two classes is storing up trouble for himself and for the plant. He lacks the mental hygiene point of view that Southard suggests the employment manager should have. Even the highly intelligent person, placed in a job demanding no exercise of his faculties, may become a subject for the psychiatrist. It is a blessing, too little appreciated, that industry has all types of jobs for all types of mentality if the latter can be discerned. The mistake of hiring none but the intelligent when monotonous jobs preponderate soon becomes apparent in discontent.

2. *The psychoneurotic.* The psychoneurotic is apparently physically healthy, yet his mind is diseased. He is emo-

tionally unbalanced, his nerves are shattered, whence he simulates physical invalidism. Stanley Cobb aptly describes this condition:

"An individual is in an intolerable situation which he is constitutionally unable to dominate; the reaction of a neurosis sets in with depression of spirits, irritability, preoccupation, self-pity, and so forth, but a conventional cause for the decreased efficiency must be found to rationalize the situation, so the individual calls it overwork. Obviously with this idea of overwork in mind the symptom usually acquired is fatigue or asthenia, but frequently symptoms more closely associated with the work are developed, such as paralysis of the parts of the body necessary for work, muscular pains making the work impossible, tremors or even epileptiform seizures."[1] Dr. Cobb describes a typical case: A woman, suffering from a severe emotional shock unconnected with her work, feels discontented with her job and develops factitious occupational symptoms of disease. When the cause of her shock is mitigated she recovers. He further states, what is important for personnel managers, that work which represses the emotional cravings often brings out neuroses, just as satisfactory work is the greatest cure there is for such conditions.

3. *The psychopath.* Persons in this class are unbalanced but not mad enough to be restrained. They are, according to Dr. Pratt, a thorn in the side of every plant management. Such persons are querulous, unruly, indisciplined, malicious, and anti-social. They are the "chronic kickers," the fractious, the peevish, the "queer guys." "Though not lacking in intellectual development," says Rossy, "they have an extremely egocentric disposition and an exaggerated opinion of their own ability, fighting with the foreman and damaging property in revenge for censure." This is the "trouble-maker" who breeds strikes, feels discontented himself, and creates discontent in the minds of

---

[1] Cobb, Stanley, M.D. "Application of Psychiatry to Industry," *Journal of Industrial Hygiene,* 1919, p. 346.

others. Dr. Bailey describes such persons as, "superficially brilliant, enthusiastic, laying some claim to brief leadership, but unbalanced, changeable, and eventually disloyal to any organization. Suggestible, they easily become the tools of designing propagandists. . . . Others are characterized by abnormal personality traits, such as suspicion, self-consciousness, obsessions, lack of control, and their social histories reveal disorders in the sphere of behavior. . . . They are individualists and unsuitable for work in cooperation with others." There are, of course, no very obvious distinction between different types. "It would puzzle the angels to make a distinction," says Southard.

Such persons as the above are sometimes a great danger, and inexplicable happenings in the plant may be traced to them. In one case, a timber yard lost $200,000 by fire and the culprit was reported to have remarked that he set the fire, "just for excitement and to see the firemen work."

THE EXTENT OF MENTAL INCAPACITY

In large organizations it is more than likely some pronounced mentally defective persons may be found. We are told, for instance, that a not inconsiderable proportion of the supposedly normal population is predisposed to mental disturbance but, since work is good for persons normally, they are saved thereby from going mad. The lowest estimate, however, is that there are four feeble-minded and two insane persons per thousand of the population. Those with evident derangement are, of course, in institutions; but many, less apparently afflicted, find their way into industry. No one can positively state the percentage of abnormals, but every plant has its quota of borderline cases. It was not until the army authorities found it necessary to choose mentally and physically normal persons that the true extent of slight mental debility was discovered. Up to May 1, 1919, the army rejected 72,000 men, of whom one-third were feeble-minded; and the first selective draft rejected

24 men per thousand because of nervous or mental disorders. In Massachusetts institutions 17,974 have mental disease, 3,470 are feeble-minded, and 1,285 are epileptic, the total forming 0.46% of the population of that state.

There is no reason to suppose that the percentage of mental cases is less in industry than in the general population. However, in a Boston department store it was found that, out of a group of 4,000 employees, mainly young women, 405 manifested functional nervous disorders accounting for about 10% of the total time lost.[1]

It is hardly necessary to enter into a discussion of the causes of mental derangement; they lie almost wholly outside the sphere of influence of industry. "Heredity," says Dr. Sidney Kuh, "does play a major rôle in epilepsy, in insanity of the manic-depressive type, in hysteria, and in dementia-precox, but even in these cases hereditary influence is a more predisposing condition than a causative factor, and even here it is to be noted that vicious heredity means vicious environment and exposure to other important causes of insanity as alcohol, syphilis, and malnutrition.

What is important from the industrial view-point is that the greatest prevention of insanity is early detection and, also, that most cases of mental disease have some social complication. Miss Mary C. Jarrett, for instance, mentions such a case—a man who thought he could not do his job was found to be worrying about his wife who was ill. There are many more or less removable causes of fear in the plant; industry has done well in removing the danger of accident; it has done little to remove the fear of unemployment, the financial loss through illness, and the many other troubles that obsess the minds of working men.

THE FUNCTIONS OF THE PYSCHIATRIST

The principal function of the psychiatrist in industry is to apply ordinary common-sense to the mental problems of the employee backed up by a thorough psychological and psychiatric training. The psychiatrist must act as an aid to the employment manager, who lacks such training, in selecting and adapting the applicant and the worker to the job. The psychiatrist should seek to find out if the applicant has the necessary mental qualifications and mental attitude for whatever position is available. The individual thus comes in for an attention, "more biographical, more inquisitive, and more solicitous" than has hitherto been attempted.

---

[1] Elkind, H. B. "Mental Hygiene in Industry," *Journal of Industrial Hygiene,* July, 1924, p. 121.

The first step in this process is, of course, the coordination of information from the employment office, and, in the case of permanent employees, the medical department, the accident and operating departments; in a word, an adequate "service record" whereby individual, physical, and mental achievements may be considered as a whole from the point of view of mental hygiene.

Further, each job will need to be considered in relation to monotony and fatigue and the physical and mental equipment of the worker in relation thereto.

The psychiatrist must study and remove predisposing causes of mental difficulties whether they occur within or without the plant, since mental, like physical, disease can be more easily prevented than cured. "Every effort should be made to discover employees who are dissatisfied; to ascertain their problems; and to learn whether these problems are manifesting themselves in neuroses, obsessions, phobias, hysterical manifestations, or other mental or physical symptoms."[1] Hence all gradual loss in production, friction with the foreman, all grievances and cases of discharge and turnover may be studied in terms of psychiatric science. As Dr. Dersheimer says, "It is of supreme importance in every accident to learn whether the patient is angry . . . . and to discover some means of satisfying the desire for revenge."

---

[1] Dersheimer, F. "Practical Mental Hygiene in Industry," *Journal of Industrial Hygiene,* May, 1923, p. 3.

Dr. Stanley Cobb, discussing the question of turnover, says, "Before these people have left their work or have been fired for inefficiency, they should be interviewed by some one competent to understand them and their probable troubles. At such times advice from a physician, the loan of some money, a visit to a sick child or wife, or any of the thousand possible personal and individual aids, might save the worker from being soured, keep him from joining the ranks of the discontented, and prevent the development of a litigant and paranoid personality."

Misplacement of workers is the basis of much mental trouble as of inefficiency. Lack of psychiatric training makes it impossible for an otherwise capable employment manager to select judiciously and, even in plants where vocational selection has been given attention, there is need of psychiatric assistance.

Psychiatric work in industry may include the following:

1. Mental
    - (*a*) Excluding the mentally unsuitable
    - (*b*) Training to upgrade the defective
    - (*c*) Training of the employment staff in mental hygiene
2. Inspection
    - (*a*) Secure cooperation of foremen
    - (*b*) Supervise individual performance
3. Medical
    - (*a*) Physical examination of workers
    - (*b*) Compilation of medical and family history

The need for psychiatry in industry is evident and we are coming to a time when its value can no longer be ignored. It may not, at present, be practicable to have a staff psychiatrist, but it is possible to insist that the doctor shall have some idea of psychiatric problems and that the various members of the staff who deal with the employees shall have some consciousness of the importance of the subject. In special cases a trained psychiatrist can be consulted if the medical staff is not trained sufficiently. The first step is that those who are responsible for handling labor matters should be conscious of the mental problems that lead to trouble.

At Dartmouth College, its President, Dr. E. M. Hopkins, tells us, a psychiatrist has been employed for the last three years, and his services have been of incalculable value.

IX

MEDICAL TREATMENT

Basis of sickness experience. Promptness a necessity. The minor ailments, their ascertainment and treatment. The common cold and its extent. Epidemics and their prevention. Other minor ailments. Heart disease and its prevalence. Tuberculosis. Venereal diseases.

THE special duty of the doctor in medical work is to seek out and give intensive care to ordinary minor ailments. Unless he practices this necessary plan unfailingly his work is bound to be unsuccessful. He must be energetic in discovering the early symptoms of disease in each individual and treat them promptly and thoroughly. Dr. H. Zinsser says, "A system of prompt information of early cases is by far the most important factor for success." This plan must be coupled, of course, with purely preventive measures.

Any worth-while plan must be based on a knowledge of the incidence of disease in general and the relative importance of each disease in the plant itself and outside since not all ailments originate in the plant. An estimate was made of the lost time in four Rochester, New York, plants in 1923 and the following facts were disclosed:

TABLE 16

LOST TIME AS A PERCENTAGE OF TOTAL FACTORY HOURS, 1923

Cause	Men	Women	Total
Illness	2.26%	5.17%	3.04%
Accidents			
During working hours	.13	.11	.13
After working hours	.07	.10	.08

In the above case 92% of the time lost was due to sickness and only 8% due to accident among male employees.

These figures amply establish the fact that sickness deserves more attention than accidents as a cause of lost time.

The Edison Company, of Boston, Massachusetts, with an average of 2,233 employees, most of whom were American-born males, made an investigation as to its sickness rate during 1918-1922. Many of the employees had been subjected to physical examination at entrance and the majority of the cases of sickness had been seen by a physician and diagnosed within 36 hours of occurrence. Table 17 gives a list of the sicknesses, their number, and the total days lost.

TABLE 17

SICKNESS EXPERIENCE OF THE EDISON COMPANY, BOSTON, 1918 TO 1922[1]

Diseases	Number of Cases	Working Days Lost		Average Working Days Lost
		Number	Percentage	
Common colds..........	5,328	16,983	20.4	3.2
Dysmenorrhea.....	683	1,486	1.8	2.1
Diseases of the stomach...... ..	1,246	2,647	3.1	2.1
Pharyngitis and tonsillitis.. .	1,007	4,698	5.6	4.9
Functional nervous diseases.... .	731	6,882	8.2	9.4
Rheumatism, arthritis, gout .	651	4,781	5.7	7.4
All diseases............ .	14,280	83,280	..	5.8

Figures such as the above show the predominance of certain ailments, and measures must be taken accordingly. The most efficient measures for the treatment of the predominant diseases must be chosen and, when selected, used invariably; that is to say, methods must be standardized as far as practicable. Workers get the idea that a doctor does not know what he is about when different methods of treatment are used for the same complaint. Moreover, standardization increases the possibility of improved technique and tends to save time since it is possible to provide for treatment beforehand.

---

[1] Sappington, C. O. "A Five Years' Sickness and Accident Experience in the Edison Electric Illuminating Company of Boston," *Journal of Industrial Hygiene,* July, 1924, p. 82.

In interviewing the patient the doctor must bear in mind that the employer is paying for the time lost by the worker coming to the medical department as well as for the medical treatment, so that speed, not haste, is advisable. The attitude of the plant physician should be that of the private physician with a private patient, nothing more nor less. In order to save time and avoid inquisitorial questions the doctor should have before him the complete medical and employment record of each patient, which increases also the possibility of a correct diagnosis.

Remedies, when prescribed, should be simple, few and innocuous so that there will be little danger of an overdose. If medicine is given in small quantities waste is avoided and the patient is forced to return frequently until a cure is effected. In treating non-English speaking workers it may be advisable to give single doses of medicine immediately or have an efficient interpreter who will explain how and when medicine should be taken.

Prompt visits by workers on the slightest symptoms of approaching sickness can only be secured by a sympathetic attitude of the foreman and by a thorough training of the workers as to its importance. Treatment must aim to abort the disease, relieve the symptoms, and restore the patient promptly to work. It is, however, better to err on the safe side if complications are to be feared.

The character of each case suggests appropriate measures for prevention of other cases and this is a subject to be kept always in mind. Since an attack of communicable disease may originate inside or outside the plant the source may be sought in both places, the cause suggesting the remedy. The condition of the worker, his clothing and personal habits, his home, the presence of epidemics in the neighborhood, as shown by local health reports, may provide indications as to external origin. In the plant the doctor must consider the department, the occupation, the conditions of work, shop overcrowding, bad lighting and ventilation, spitting and improper methods of cleaning, and unless conditions are satisfactory there will be similar occurrences of the same disease.

Certain minor ailments, which the family doctor seldom has a chance to treat, need major attention in industry. It is said that the time lost by sickness during 1923 amounted to the full working time of a million workers. Of this total more than half resulted from only three or four common ailments, while some of the most virulent diseases were a negligible factor. Chief among the causes of industrial sickness are the respiratory diseases, of which the principal one is the "common cold" in the treatment of which prophylaxis is most important, particularly in the larger plants. The common cold, as every one knows, begins with sneezing, nasal congestion and headache; thus, there are both auditory and visual signs of infection and therefore the means of control are promptly possible. Each case suggests physical unfitness, overwork or unsanitary conditions in the shop or the home, the need for isolation and for preventing the spread of infection. In such cases, Dr. H. Zinsser recommends the following procedure:

1. Information for the worker, by circular or conference, describing the infection of colds, its secondary danger and mode of conveyance.
2. Use of paper handkerchiefs and paper bags for soiled ones by workers which should be promptly burned after use.
3. Persons sneezing or coughing should be excused from work or isolated in special parts of the room, and persons whose temperature reaches 100 degrees Fahrenheit should be warned against family contact and sent home.

Too much attention cannot be paid to the common cold by the plant physician. It starts with one individual and runs through the plant, causing marked physical debility, if not actual absence, with a resulting loss in production which must be quite serious in the aggregate. Lost output from disability without absence may be as serious as that occasioned by absence and, as seen in the Edison figures quoted on page 128, 20% of the total time lost was due to common colds. Vaccine as a prophylactic or abortive agent is now coming to be used because although the malady is slight its economic waste is enormous.[1]

Interest in the subject of common colds is increasing and, early in the summer of 1923, the United States Public Health Service undertook a special study of the subject.[2] It was found that, of the 1,085 diagnoses of influenza, colds, bronchitis, and sore throat, no less than 940, or 86.6%, were colds.

Colonel E. B. Vedder, chief of the medical research division of Edgewood Arsenal, at the annual session of the American Congress on Internal Medicine, March 8, 1925, spoke on the use of chlorine gas in the treatment of respiratory diseases. He says that the gas is now being used in large industrial establishments. At the Arsenal, 93%, in 440 cases of common colds, had been cured or greatly improved.

EPIDEMICS

In no particular is there less vision in industrial medicine than in the matter of epidemics. Their comparative infrequency take people unawares and the situation is out of hand before measures are taken to prevent what is generally a serious loss in production. It is not from the occurrence of trachoma, small-pox, typhoid or diphtheria that the doctor need concern himself so much as that of influenza. An epidemic afflicts a large number of persons at the same time, in the same place, in the same way, and of epidemics, influenza is by far the most common and disastrous. Influenza is not dangerous in itself, but it renders the body subject to many serious complications, hence it must be treated as a dangerous disease, and it has extreme communicability.

The so-called "flu," "grippe," "Spanish Influenza," or

---

[1] Lytle, A. T. "Common Colds," *Industrial Doctor,* April, 1924, p. 51.

[2] Townsend, J. G. "Epidemiological Study of the Minor Respiratory Diseases," *Public Health Reports,* October 24, 1924.

"Three Day Fever" of 1918, was first found in Russia, Germany, and France and originated doubtless from lowered vitality due to the rigors of war. Once it became established it attacked persons indiscriminately. A month or two later it reached eastern United States and spread westward. The loss was enormous. Insurance companies reported more than 150,000 deaths for the period from influenza and its complications. One industrial company had a death-rate six times as great as in the previous nine months.

Never in the history of industrial medicine has there been so complete proof of the value of intelligent action by the plant physician. Those companies which saw the storm coming and made due preparations to meet it were amply rewarded. Others were almost forced to shut down while the epidemic raged. An official of a large telephone company said, on October 22, 1918, "We are short 2,000 operators. Under normal conditions we have 6,402 operators." Practically one-third of the operating force was sick with influenza. Another plant, where some measures were taken to combat the disease, had a maximum absence rate of 13% for males, and 22.36% for females for all causes, while the average for the whole plant for the month of October, when the disease was most virulent, was 19.6%, or about 13% above the ordinary average. In companies where intensive measures were taken the average absentism rose *only slightly* even when the epidemic was at its height.

In general the ordinary maintenance of health is the best preventive. The imminence of an epidemic, therefore, should prompt an intensive health educational campaign among the workers, and the employer should attempt to modify conditions within the plant that tend to overwork. It is, for instance, fatuous to tell employees to avoid overexertion at home and to permit overtime in the plant to make up for the shortage of labor due to sickness.

The chief factors in prevention are publicity, disinfection, isolation, ventilation, and vaccination. Publicity may take the form of talks to employees by the doctor on general health maintenance and on the specific dangers of the disease. In the case of influenza, rules, such as the following, may be given wide circulation:

1. Avoid the company of persons with "colds."
2. Avoid crowds in poorly ventilated places—picture shows, and so forth.
3. Avoid use of common drinking cups or towels.
4. Keep face, hands, and body clean.
5. Report immediately to doctor in case of symptoms appearing.

Periodic talks and frequent distribution of literature are advisable during the height of the epidemic, each piece of literature being written in the plainest terms.

Disinfection, particularly in places of common contact, is of some importance. Telephone booths and mouthpieces should be cleaned frequently, as should rooms, lockers, and places where employees congregate. If there is a lunch room, all utensils, plates, dishes, and cutlery should be thoroughly disinfected after use.

Isolation, practical and, indeed, imperative on the case of some diseases, is impracticable in the case of influenza, cases being too wide spread and too light. In the earlier stages of the epidemic, however, "the importance of isolation as a measure of prophylaxis could not be too strongly urged."

Good ventilation prevents infection by keeping up the general health and by lessening the number of infective droplets. The regulation of ventilation should be centralized and some one person should be made responsible for its control. The heating of the plant should likewise be controlled.

Vaccination was resorted to in some plants and with a measure of success. However, it is clear that the most frantic search for an anti-influenza vaccine was unnecessary. The real enemy was pneumonia and inoculation against this disease gave very satisfactory results. In the Youngstown Sheet and Tube Company, 5,072 employees were inoculated without compulsion and without cost. The results showed that those vaccinated seldom got the disease while among the unvaccinated about 10% were affected.

Dr. C. E. Turner[1] advocates the following steps in prevention:

1. General manager of plant is warned of the possible danger.
2. Plant physician secures facts as to the approach, nature, and treatment of the disease.
3. A committee is formed in the plant consisting of the medical staff and the foremen.
4. Leaflets are distributed to foremen, describing symptoms and asking to have cases reported promptly.
5. Cooperation of local health agencies is secured.
6. Education of workers through posters.
7. Hospital facilities arranged for in advance.
8. Use of common cups and towels discontinued.
9. Disinfection of lunch-room dishes and crockery.
10. Influenza vaccine supplied to all doctors and nurses.
11. Reports from all departments daily.
12. Supervision of food-handlers.
13. Repetition of instructions to foremen and workers; periodical distribution of posters and leaflets.

During the epidemic in 1918 the Retail Credit Company, which inoculated all of its employees without cost, obtained the following interesting results:

RETAIL CREDIT COMPANY SUMMARY OF HEALTH REPORT, 1918

Days off from preventable causes (cold, grippe, sore throat, indigestion, and so forth), 277½—salary loss, $951.49.

Days off from unavoidable causes (operations, eyes, ears, vaccinations, mumps, influenza, and so forth), 463½—salary loss, $2,083.34.

Days off from unknown causes, 26¾—salary loss, $128.79.

Total days off, 767¾; total salary loss, $3,163.62.

---

[1] Turner, C. E. "Organizing an Industry to Combat Influenza," *Journal of Industrial Hygiene*, 1920, p. 448.

AVERAGES

Average salary loss per employee in organization....	$21.97
Average salary loss per employee sick..............	29.56
Average number of days lost per employee sick......	7.17
Average number of employees sick in organization....	70%
Average number of women employees sick.........	100%
Average number of men employees sick...........	59%
Average number of days lost per woman employee...	8
Average number of days lost per man employee......	3.7
Total number of days lost by women employees.....	440
Total number of days lost by men employees.......	327¾

OTHER COMMON MINOR AILMENTS

Headache is one of the minor, though frequent, complaints in industry, constituting about a fifth of all cases that come to the doctor's attention, especially in the case of female workers. It is a symptom of a wide variety of conditions, chief of which are colds, constipation, eyestrain, overwork or worry. In this, as in other cases, it is as necessary to ascertain the true cause as to bring about relief. Most headaches have their origin in some removable cause whether in the individual or in the working conditions. Cobb and Parmenter, in discussing the psychiatric headache, say, "To tell such a patient that the headache is 'imagination' is not only to show gross ignorance of the psychology involved, but it is bad therapeutics, since the patient is antagonized and can never be led to understand the real cause. Success is to be obtained only by sympathetic investigation of all the mental factors, followed by frank talks in explanation of the symptoms. In obtaining the facts in these cases, which are usually of a personal nature, a well-trained and tactful social worker is an invaluable adjunct to the medical staff."

Constipation is another of the besetting troubles of the industrial population. It is to be avoided because it lowers resistance to disease and leads to many avoidable pains and aches. In some medical departments the subject is almost ignored, yet the establishment of a "regular habit" should be one of the main features of any plan of hygienic training. In the treatment of constipation the doctor should give careful personal instructions and have printed directions as to diet for each sufferer.

In plants employing females, dysmenorrhea is one of the common complaints leading, perhaps, to much more inefficiency than is thought possible by the male, and generally unsympathetic, staff. Incidentally, too, those most concerned, from a false sense of modesty, often uncomplainingly suffer. Meaker points out, in one of the few instances where figures have been obtained, that "on the average, rather over 10% of the girls in an industrial establishment may be expected to seek relief for their menstrual disabilities during any given month." Margaret C. Sturgis gives the following figures regarding women employed in a large department store:

TABLE 18

HOW THE MENSTRUAL PERIOD AFFECTS THE WOMEN EMPLOYED IN A LARGE DEPARTMENT STORE

Particulars	Married	Single
Those who experience no discomfort	520	727
Those who begin work and later are compelled to seek relief from a hot drink, medication, or rest on a couch or bed with hot-water bottles, and so forth	148	398
Those who occasionally remain at home or go home during the first day of the period, but at other periods suffer little or moderate pain or discomfort	27	64
Those who are compelled to remain at home one or more days of each menstrual period	28	63

Improvement is secured in the following ways:

1. Talks on the hygiene of the menstrual period are given by the physician to the sponsors who have charge of groups of women. The sponsors in turn talk to the women. At the physical examination of each individual, specific instructions are given.

2. A nurse is in attendance to administer hot drinks, medication, or hot-water bottles and to permit rest.

3. Consultation with the physician in severe cases.

According to the figures submitted from a study of 2,077 cases it was found 65% had no menstrual disturbance, 30.6% had a slight menstrual handicap, and only 4.4% had any serious trouble. The measures pursued tended to overcome the habit of some not working during the period.

HEART DISEASE.

About two million persons in the United States have heart disease and the percentage is apt to be higher in industry. Hitherto heart disease has not been considered much of a problem in plants and its presence has only recently received some attention. One can see a cripple, but it is easy to overlook the cardiac patient.

It will come as a surprise to some to know that, "2% of the industrial population have serious heart defects"[1] and that 42.3 persons per thousand were rejected by the army authorities in 1918 for heart defects. In England no less than 10% of the army recruits were rejected because of heart troubles and, according to a publication of the United States Public Health Service, the following percentages of heart cases were found in certain industries:

TABLE 19

NUMBER AND PERCENTAGE OF "HEART CASES" FOUND IN CERTAIN INDUSTRIES

Industry	Number	Affected Hearts
Garment trades (male workers)	3,000	4.8%
Glass workers	1,511	8.0
Foundry workers	1,286	11.0
Chemical workers	904	6.9
Cigar workers	398	10.4
Steel workers	1,293	14.1

In the Norton Company, Worcester, Massachusetts, in 1920, however, there were only 74 cases of heart disease among 3,200 employees, a percentage of 0.95. In the latter case, it may be mentioned, there is a highly developed medical department. The subject is clearly one of interest.

---

[1] Lincoln, M. "Industrial Aspects of Heart Disease," *Journal of Industrial Hygiene*, May, 1924, p. 1.

The cause of this wide prevalence of heart disease is, of course, non-industrial in origin, arising, as it usually does, from arteriosclerosis, rheumatic fever, or syphilis, but nevertheless the industrial doctor will find it of use to his concern to take full cognizance of its prevention and treatment. He must ascertain its cause, the degree of damage and extent of physical impairment and seek to place the worker in those occupations for which his physical condition is suited. Heart conditions have been classified in terms of work; those with disease which does not interfere with ordinary work; those where effort should be slightly curtailed; those whose work should be moderately curtailed; those who should have very slight work; and persons who should do no work at all. The physician's problem is one of placement and it is obviously necessary that he should have full knowledge of the demands which each job makes on a man before assigning him in case of heart trouble. Lack of such preparation in dealing with heart cases is indicative that the doctor does not appreciate the importance of the problem.

The difficulty in treatment is one of early recognition and adjustment of the worker to suitable conditions. The problem is much increased when heart disease is found among laborers, since the finding of easy jobs increases for unskilled work. If "small work" cannot be found, the possibility of training the worker into some kind of simple light work may be considered. Whatever the character of the work chosen it should permit effort at less than capacity. Any form of light work such as drafting, small assembly, clerical, packing or wrapping clothing, or watchman will be found desirable and if it is right-handed so much the better. The universal use of the right hand is not founded on social or religious grounds so much as on the common-sense fact that it relieves the heart from strain.

Lifting, stooping, pushing, hauling, and messenger work should be avoided. On account of the fact that heart trouble frequently results from rheumatic fever it is desirable to allow no cardiac to work in damp places. The patient should, however, be as carefully cautioned about overtaxing his heart outside the plant, where there is often as much if not more danger.

The following is a list of occupations suitable for employees afflicted with heart trouble.[1]

SKILLED JOBS FOR CARDIACS

FOR MEN

Engraving, jigsaw, and assembling in celluloid novelties
Polishing diamonds
Certain kinds of drafting
Work as a barber, for cardiacs who can stand for long periods or work quickly
Pocket-book pasting
Operating and finishing garments and furs
Bookkeeping, stenography, and accounting
Retouching in photography
Proof-reading and copy-holding in the printing trades
Photographing and certain other processes in lithography
Steel engraving
Painting dolls' faces in doll manufacture
Grinding and rubber turning in fountain pen manufacture
Glueing and assembling in piano actions
Covering and machine work on buttons

FOR WOMEN AND GIRLS

Millinery processes
Pasting and sewing lamp shades
Finishing in clothing manufacture
Mending laces, and fine embroidery
Crochet beading on dresses
Fashion design
Bookkeeping, stenography, and typing
Painting and engraving celluloid
Work as a seamstress or information clerk in institutions
Sample mounting in wholesale houses

---

[1] Mitchell, Hannah. "Putting Their Hearts in Their Work," *Survey*, November, 1924, p. 125.

TUBERCULOSIS

Tuberculosis, on account of its prevalence and character, both active and potential, is perhaps one of the most serious medico-industrial problems. It is peculiarly a man's disease because man is subject to the predisposing causes more commonly than woman. Tuberculosis is a plant, as much as a social, problem; all that is required to induce tuberculosis is a feeble physique, the presence of the tubercular poison, and dusty, damp or fatiguing work. The purpose, therefore, of the plant physician is to eliminate and exclude the tuberculous in order to protect the working force and to adopt means of restoring infected employees.

No less than 100,000 persons die from tuberculosis every year, and it is stated that about 1% of the population have active tuberculosis, principally as a result of unfavorable working conditions. Sir Thomas Oliver[1] tells us, "At the copper works in Montana, out of 1,614 deaths during 1907 and 1914, 37.9% occurred in miners and were due to pulmonary tuberculosis; whereas among the non-mining class only 10.8% died from this disease. These facts certainly point to dusty occupations creating a favorable soil to the development of tuberculosis." Many of our industrial processes involve the incidental production of dust and it is believed that about 10% of all workers are subject to more or less deleterious conditions of the kind. Confirmation of the fact is shown by an investigation made by the Prudential Insurance Company of tuberculosis among glass workers where the incidence of disease, the same between the ages of 15 and 24, advances rapidly among glass workers in comparison with that of the general population, in the higher age groups. Statistics show the greater prevalence of tuberculosis among indoor than among outdoor occupations, among dusty than non-dusty trades and in some kinds of dust more than others. The ratio of respiratory illnesses to deaths from respiratory causes was more than 300 to 1, in a recent study of a general population group in Hagerstown, Maryland.[1]

---

[1] Oliver, Sir Thomas. "Pnthisis and Occupations," *Journal of Industrial Hygiene,* April, 1920.

The causes of tuberculosis lie within, as well as without, the plant. The individual may be exposed to infection in his home perhaps more than in the plant even though the area of possible infection is wider. Outside the plant physical debility, neglect of common colds, bad living conditions, overcrowding, inadequate and unwholesome food are potent predisposing causes for which industry is hardly responsible. In the plant there is, of course, danger of direct infection, overwork, fumes, humidity, heat and damp, bad posture in more or less degree, all of which tend to create a lodgment for the disease.

The medical problem has two aspects, that of preventing infection and that of preventing the spread of the disease, mainly through the physical examination of applicants and employees. The employment office may aid the medical department by excluding the weak-chested, flabby-muscled applicant, or one who shows indications of defective physical development. Incidentally, too, it is injudicious to hire persons who live a long distance from the plant, because the homeward journey in crowded cars, after a fatiguing day's work, is a condition which renders persons susceptible to infection.

Methods of prevention must include a consideration of the employee, his personal habits and the conditions under which he works, from the physical, educational, and sanitary standpoints. The doctor must seek to correct faulty personal habits, to secure sobriety and moderation in living; he must aim to educate the worker as to how to avoid the disease by means of the publication of such literature as is issued by various public and private associations, and he must, at the same time, attempt to raise the sanitary and hygienic standard of the plant. Control of the disease depends on physical examinations which are the beginning, and not the end, of treatment. Workers showing indications of disease are periodically examined and advised as to the nature and methods of improving their health. They are given work suitable to their complaint and are allowed such conditions as will give them an opportunity to recuperate without affecting their industrial usefulness.

---

[1] Sydenstricker, E. "The Incidence of Illness in a General Population Group," *Public Health Reports,* February 13, 1925, p. 290.

The George E. Keith Company issues to all its employees the following bulletin which is typical of such literature:

> Consumption is tuberculosis of the lungs, and is caused by a very small germ which is taken into the body through the nose or mouth in dust or in food.
>
> It is never caused by anything else but this germ.
>
> It is a preventable disease.
>
> It is often cured if taken in time.
>
> It kills one in every ten persons who die.
>
> *Suspicious symptoms are:*
>
> Continued coughing or spitting in the mornings even if only a little.
>
> Weakness or loss of weight, very suspicious, especially if there is a slight cough.
>
> If blood is coughed up, the cause is almost always tuberculosis.
>
> A little fever in the afternoon points to this disease.
>
> Pains in the chest—pleurisy—and night sweats are very suspicious.
>
> If any of these symptoms are present, no matter how well you look or feel, go to your physician, or to the Health Clinic, and explain your case. Thousands of consumptives who have had proper treatment are well today.
>
> *Some ways to avoid consumption:*
>
> Keep the windows of your bedroom wide open at night.
>
> Get plenty of sleep.
>
> Take a cool bath with a brisk rub down every morning.
>
> Keep track of your weight. If you are losing weight a doctor will tell you why.

Do not take patent medicine.
If you keep yourself in good health, tuberculosis germs cannot hurt you.
Leave alcoholic liquor alone.
When you cough or are run down do not wait until too late before seeing a doctor.
Consumption is caught from the spit.
Do not spit on sidewalks, floors, or playgrounds.
If you must spit, spit in the gutters, spittoons, sewers, or best of all, in the fire.
When you cough or sneeze, try to have your handkerchief over your mouth or nose.

In planning a campaign against tuberculosis it is, of course, important to determine its relative importance in the individual plant by physical examination of the workers as a whole and occupationally, and should there be some specific occupations where a high rate of pulmonary disease is shown, efforts may be concentrated in selecting robust workers for such jobs, eliminating those physically weak, rotation of occupation, and removal or mitigation of the evident predisposing causes. Marble and stone cutters are peculiarly susceptible to tuberculosis, as are compositors, printers, bookkeepers, and clerks. The problem will be much less acute in the case of carpenters, masons, railroad employees, and agricultural laborers. Dr. E. R. Hayhurst says, "It is startling when we realize that such an innocent occupation as that of the telephone girl is associated with a tuberculosis rate of 43% of all deaths among this class of workers, and that the stenographer suffers a rate of 39% from the same disease."[1] The cause, of course, varies in character and intensity in different occupations. Telephone girls are susceptible through physical as well as occupational reasons; they are generally young and have to strain their voices and lungs, sometimes in dusty places. In other occupations dust is the promoting cause, though the character of the dust affects the amount of the disease. Mortality increases successively from vegetable, mineral, animal, to metallic dust, the latter being the most destructive of all.

---

[1] Hayhurst, E. R. "The Relation of Industry to Medicine," *Ohio State Medical Journal,* December, 1916.

The most important factor in dealing successfully with tuberculosis in industry is prompt discovery of incipient cases. The Prudential Insurance Company collected data for 1909-1919 which showed that comparatively few incipient cases treated in sanatoria die, but that fatality rapidly increases with those who seek curative treatment in the advanced stages. It is, therefore, a prime duty, especially in the case of damp or dusty occupations, to keep a watchful eye on the working force, and to give individuals the means of helping themselves. It may seem incredible, though true, that in some of the prominent plants of the country a scale for testing variations in weight of incipient cases is not to be found. Since treatment of tuberculosis is a long, tedious, and expensive process it is imperative to devote intensive effort to prevention by such means as periodic weighings.

Of 431 industrial establishments investigated by the United States Department of Labor, in 1916-1917,[1] it was found that 32 companies send their afflicted employees to sanatoria while a like number pay all expenses of employees with a reasonable length of service. At the Mount McGregor Sanitarium of the Metropolitan Life Insurance Company 84% of those admitted in the incipient stage were able to return to work while only 20% of those who were far advanced survived and returned to work. This treatment is entirely free and the patient is assured of his position on recovery. In Chicago a number of companies have united to establish a sanatorium in New Mexico to which employees are admitted at cost. It is obvious that, for smaller companies, prevention by education should be pursued thoroughly and systematically.

---

[1] "Welfare Work for Employees in Industrial Establishments," *Bulletin Number 250,* Bureau of Labor Statistics, Washington, D. C.

VENEREAL DISEASES

Superficially there is no syphilis in industry, at least the word is not mentioned in some medical records. A case has occurred where the physical examination of 1,200 workers disclosed no instance of venereal disease! Although the percentage of syphilis varies in different occupations it is incredible that any large plant can be entirely free from it. This social menace is not, of course, an occupational disease but, in certain stages it may be acquired in the locker room, the lunch room, in toilets or wash-room, and in the course of work where men handle the same tools.

Syphilis is a disease which can be acquired in a few minutes and take as many years to cure. It affects happiness and the lives of those affected, leads to industrial inefficiency and disaster, and is the cause of much lost time and expense for treatment. "While the acute primary and secondary lesions are a possible source of infection to hundreds of innocent employees, it is the chronic tertiary untreated or insufficiently treated cases that work havoc in industry. They are the potential causes of accidents to themselves and to others. When injured, their disability is always prolonged. They are generally chronic absentees—inefficient employees—and a source of trouble at all times." [1]

Industry suffers through the presence of syphilitics in other ways. They are specially liable to tuberculosis and other diseases, and their injuries are aggravated by the presence of the poison. It is not too much to say that all syphilitics are potentially unsafe as workers.

There is no very clear proof of the presence of venereal diseases in industry, but in his annual report for 1919 the Surgeon General of the United States Army said, "It is probable that the figures for the second million (of recruits) of 5.6% showed more clearly the correct percentage of the drafted men from civil life who were infected with venereal diseases." There is thus no reason to suppose that the rate is very different in industry. Stokes and Brehmer, in an investigation of unselected cases in various occupations, found the following figures: [1]

---

[1] Oliver, E. A. *Syphilis.* Paper read before the Fourth Annual Convention of the American Association of Industrial Physicians and Surgeons, June 9, 1919.

TABLE 20

NUMBER AND PERCENTAGE OF MALE CASES OF VENEREAL DISEASES IN VARIOUS OCCUPATIONS

Occupational Types	Number	Percentage
Railroad employees	128	11.7
Laborers	243	6.1
Business men (tradesmen, merchants)	236	3.8
Farmers	536	1.5

The Life Extension Institute, in various groups of industrial workers examined, found less than 1.0% with a history or clinical signs of syphilis, and without the assistance of Wassermann tests except in suspected cases. It is important to note that negro workers show a much higher rate of infection than whites. Segregation of the two groups may, therefore, be advisable on such grounds.

The difficulty of diagnosis and the lack of frankness on the part of the worker make the problem one of some uncertainty. As a rule the presence of syphilis is unanticipated in industrial physical examinations, and it is stated that, "except in very obvious cases detection of the disease is impossible."[2] Stokes and Bremer, however, say, "An interesting sidelight is thrown by these figures on the presence of syphilis in general as detectible by general medical examination. . . . Our results showed that only 3.1% of syphilis was detected in our patients when subjected to general medical examination."[3] Of the total diagnosed, 41.3% were made by the routine physical examination.

---

[1] Stokes, J. H., and Brehmer, Helen E. "Syphilis in Railroad Employees," *Journal of Industrial Hygiene,* Jan., 1920, p. 419.

[2] Edmunds, Page. "The Role of Syphilis in Industrial Disablement," *Journal of Industrial Hygiene,* 1922, p. 384.

[3] *Op. cit.*

The medical selection of workers for employment has two phases: the preliminary inspection and the physical examination proper. In the first phase the prospective employee is given the critical "once over" and it is here that the outward evidences of syphilis may be detected even in the employment office. As a rule not one but several signs are sufficient to give confirmatory evidence of the presence of the disease. It needs no special training to detect the ataxic gait, defective hearing, and abnormalities of voice, and in some cases, erratic conduct, bad temper and megalomania. If these are accompanied by irregular, pinhead or unequal pupils reacting abnormally to light, and swaying when the eyes are closed it would hardly be necessary to proceed further with the examination of an applicant. In the case of employees, of course, the presence of syphilis must be established and this may perhaps be done in the course of the periodic physical examination where the employee is stripped, his genitals examined, muscles flexed, and so forth. Diagnostic signs of the sort can easily be ascertained without adding materially to the length of the physical examination, but a Wassermann test should be made in all suspected cases.

Every effort should be made to induce employees to accept treatment which, though troublesome and tedious, will probably be more economical for the employer in the end. It is the best method to avoid the spread of the infection. If the medical department cannot undertake treatment it should induce the patient to avail himself of the aid of the United States Public Health Service which is now cooperating with the state boards of health for the eradication of the disease. An alternative is to supply patients with arsphenamine and mercury at cost. It is the expense of outside treatment that often prevents persons from seeking a cure.

The losses to industry from this disease are considerable in time, money, and human suffering. Much time is lost, not only in securing periodic treatment over a long period but from the disease itself and the resulting disability. "Based on the army figures the yearly time loss through venereal diseases in manufacturing industries is 6,893,800 days."[1] In the army there is an average of 10 days lost in each case and in industry it has been ascertained that injured syphilitics take 50% more time to heal than healthy persons. The money cost for treatment in the average case amounts possibly to $100. In compensation cases it was found to average $143.

Industry can hardly do much in direct prevention except in the treatment of diseased persons, in individual education, and in properly supervised recreation. The direct education of the worker as to the dangers of syphilis is part of the scheme of general health education. Much literature is now available for this purpose. The United States Public Health Service distributes pamphlets, bulletins and placards on request specially designed for distribution to employees in industrial establishments. It proposes, also, to give confidential interviews to ailing employees, free lectures to groups, and physical examinations by competent medical men. The American Social Hygiene Association provides, at cost, forceful, up-to-date literature which has, in fact, been used by such companies as the Phelps-Dodge Corporation, the Hercules Powder Company, the E. I. Du Pont de Nemours Company, the Kelly-Springfield Company, and the Westinghouse Company.

In certain communities, such as Rochester, New York, active steps have been taken by the community, and a place for the treatment of venereal diseases has been established and is increasing in use ever since. "It was by advertising in the newspapers, and by advertising alone, that a knowledge of this work was extended and patients came to the clinics."[2] The opportunity for outside treatment is often desirable in dealing with this disease. Employees as yet do not always trust the plant medical service enough to confide in it, or to consult the plant superintendent as in some cases they have been invited to do. A systematic effort, therefore, should be made in all cases by plant medical departments to cooperate and encourage the cooperation of public agencies engaged in fighting this disease, particularly in ascertaining its point of origin.

---

[1] Everett, Ray H. "The Cost of Venereal Disease to Industry," *Journal of Industrial Hygiene*, 1920, p. 178.

[2] Zoler, George, and Roby, J. "Work Against Venereal Disease in Rochester," *The Nation's Health*, May, 1923, p. 259.

The literature to be distributed is of various kinds, consisting of instructions to foremen and superintendents, a confidential report card, bulletins, information for infected persons, pamphlets to warn the healthy against disease, pay-envelope slips, and placards for toilet- and wash-rooms. Those who are responsible for the education of the worker should not be contented with the mere distribution of literature. Enquiries should be made of individuals as to whether it has been read, understood, and acted upon. A summary of the results will usually furnish good material for group talks.

There are many indications that plant physicians have not given sufficient attention to the subject of venereal diseases in industry. Syphilis seems to be increasing and it is the direct or indirect cause of industrial inefficiency. The occasion, therefore, demands that the routine physical examination should be intensive enough to detect its presence in both applicant and employee, the former for the purpose of exclusion and the latter for establishing a cure.

X

OCCUPATIONAL DISEASES

Extent of occupational diseases. Their classification. Relation to workmen's compensation. Causes. Prevention Protection. Lead poisoning; its extent, properties, and prevention Mercury. Multiple poisons. Carbon monoxid. Nitrous oxide Benzol. Artificial respiration.

In some plants there is an almost entire freedom from what may be termed occupational disease; in others it exists to an extent often unrealized. An occupational disease is one attendant on, and peculiar to, a specific occupation or industry and for which the process is wholly or principally responsible. Ordinarily tuberculosis and rheumatism are not occupational diseases, but in some wet or dusty trades they may almost be regarded as such. "Acute rheumatism," says Dr. Hutchinson, "is essentially a working class disease." In the broader acceptation of the term, therefore, occupational diseases are those of ordinary origin when aggravated by industrial conditions. But whether one considers such maladies as occupational or not, they constitute a drain on the resources of the worker and on industry.

The subject of occupational diseases is difficult and the factors leading thereto are in a constant state of flux. Individual plants grow rapidly, processes change, new ones are acquired or created, and the materials with which the operations are carried out vary in character and chemical composition. Moreover, there is a difficulty in detecting comparatively rare diseases; poisons and their combinations are numerous and complex; some are innocuous as metals and virulent as salts; some neutralize or intensify one another, while others, considered dangerous in general, act as specifics for certain common complaints, as in the case of sulphurous acid gases which have been used in throat affections. In addition, the physiological action of chemicals and drugs varies, and workers display a wide range of tolerance.

THE EXTENT OF OCCUPATIONAL DISEASES

Considered in relation to other diseases occupational maladies occupy a very small field, but as a plant problem, in certain cases, they may be of paramount importance. It is the function of the plant physician to determine the character of the occupational diseases and their relative importance in plant morbidity. Medical research has occupied itself with numerous studies of industrial diseases on account of their unique characteristics and virulence; the literature on the subject is quite extensive. But while the plant physician should familiarize himself with the subject, and even assist in investigative work, he should realize the relative importance of the rare to the commoner, but less interesting, ailments.

Plumbism, which is easily the most prevalent of plant poisons, is the cause of less than one death per thousand. There are, in fact, 200 deaths from the respiratory diseases for every one from lead poisoning. Moreover, all other occupational and chronic poisonings combined are less than half those due to lead. These are general averages not necessarily true as to the individual plant. It is for the plant physician to ascertain the existence of occupational hazards, and if found they become of vital importance.

Occupational hazards are indicated by disease as well as death. The rate of recovery to death varies as well as the time taken in recovery. Figures from the New York State Department of Labor, as reported under Section 206 of the Labor Law, from 1912 to 1923, show the cases and deaths given in Table 21, on the following page.

Lead is apparently the preponderating cause of occupational sickness and death, constituting 88.2% of all cases and 86.0% of all deaths reported. These figures are rela-

TABLE 21

CASES AND DEATHS FROM OCCUPATIONAL POISONS, NEW YORK STATE, 1912 TO 1923 [1]

Occupational Poisons	Cases		Deaths	
	Number	Percentage	Number	Percentage
Lead manufacture	402	88.2	37	86.0
Brass	19	4.2	2	4.7
Arsenic	15	3.3	..	.....
Mercury	12	2.6	2	4.7
Phosphorous	1	.2	1	2.3
Wood alcohol	7	1.5	1	2.3
	456	100.0	43	100.0

tively small considering industry as a whole, but the rate in some plants where lead is in use is abnormally high. Such figures, however, represent the minimum; many cases of industrial poisoning occur without being recognized or reported. The New York law, for instance, requires reporting in only a limited number of poisons.

The occupational diseases reported in Ohio to the State Department of Health, and to the Department of Industrial Relations, between August 4, 1921, and December 31, 1923, are as given in Table 22, on the opposite page.

CLASSIFICATION OF OCCUPATIONAL HAZARDS

Dr. E. R. Hayhurst classifies the special disease hazards of occupations somewhat according to the following groupings: [2]

1. Metals
    (*a*) Filings, dust and fumes of metals or their salts
    (*b*) Poisonous metals: arsenic, antimony, brass, lead
2. Dusts

---

[1] *Annual Report of the Industrial Commissioner,* for 12 months ending June 30, 1923, p. 95. New York State Department of Labor.

[2] Hayhurst, E. R. "The Significance of Occupational Diseases," *Monthly Bulletin,* Ohio State Board of Health, June, 1913.

- (*a*) Insoluble inorganic dusts:
  - Flint, silica, sand, cement, marble, lime
- (*b*) Soluble inorganic dusts:
  - Soluble metallic salts and compounds
- (*c*) Organic dusts:
  - Fur, skin, hides, flour, tobacco, jute

3. Gases, vapors, fumes
   - (*a*) Illuminating gas, carbonic acid gas
   - (*b*) Mineral acids
   - (*c*) Tar, creosote
   - (*d*) Nitro and amido compounds

TABLE 22

OCCUPATIONAL DISEASES REPORTED TO THE OHIO STATE DEPARTMENT OF HEALTH, 1921-1923 [1]

Kind of Disease	Cases Reported
Ammonia poisoning	1
Aniline poisoning	7
Arsenic poisoning	11
Benzine and benzol	53
Gasoline	5
Carbon monoxide	3
Dermatitis	2,197
Lead poisoning	557
Mercury poisoning	5
Para-nitraniline	3
Zinc (brass) poisoning	20
Anthrax	1
Other poisons	11
Other occupational diseases	67
Reported by self-insurers (not classified)	326
	3,267

The physical characteristics of these poisons vary considerably and their toxicity depends on solubility or mobility. The principal forms are solids, gases, liquids, and their intermediates, fumes and dusts. Few solid metals are harmful but, as dusts, they may be easily absorbed. The fumes of such metals may be deadly. The poisonousness of the salts of these metals depends largely on solubility. One may swallow an ounce of mercury with impunity because it passes quickly through the system unchanged, but not half a grain of any of its salts.

---

[1] Hayhurst, E. R. "Status of Occupational Disease Question in Ohio," *Journal of Industrial Hygiene*, October, 1924, p. 259.

These substances enter the lungs in breathing, the digestive tract in swallowing or through the skin by absorption and act on the body in various ways. They may alter the character of the blood, injure the system or cause irritation or corrosion on the skin and tissues. They act sometimes chemically, sometimes mechanically on the physical structure.

OCCUPATIONAL DISEASES AND WORKMEN'S COMPENSATION

Industrial diseases become significant from the economic view-point because there is an increasing tendency to make employers shoulder the cost of compensation by means of the workmen's compensation acts.

In 1920 only eight states provided for the compensation of occupational diseases. By the end of 1922 eleven states had adopted such measures.[1] Even before the institution of such special provisions in California, Connecticut, Hawaii, Illinois, Massachusetts, Minnesota, New York, North Dakota, Ohio, Porto Rico, and Wisconsin, certain occupational diseases have been compensated for on occurrence, "suddenly and violently" in the course of employment. Pennsylvania, for instance, in 1923, paid for a compressed air illness although it does not pay for occupational diseases. In Canada and England, occupational diseases are paid for, and, in the latter country, 27 diseases are included.

In many cases the compensation is paid for on the grounds of accident and not on disease, the factor of time appearing to be the determining cause. In Oregon an occupational disease, such as lead poisoning, is considered "non-compensable" on the grounds that it is not "a personal injury by accident."

---

[1] Clark, L. D. "Disease as a Compensable Injury," *Monthly Labor Review,* July, 1924.

A good illustration of the narrow margin that separates a compensable from a so-called non-compensable disease is shown by three cases of anthrax. Two workers contracted the disease, one without any perceivable wound to give entry, and the other through a cut from a barber and no compensation was paid in either case. A third worker contracted anthrax through an abrasion on his neck while handling hides in the plant and was compensated. A further indication, however, of the trend of the times, is the recent amendment to the Federal Compensation Act which plainly includes occupational diseases. The approval of the President of the United States was secured to the amendment to section 40, which makes, "any disease approximately caused by employment" an injury within the meaning of the act.

The New York Workmen's Compensation Law pays for disabilities sustained or death incurred by an employee from anthrax, lead zinc, mercury, phosphorous, arsenic, wood alcohol, benzol, carbon, bisulphide, nitrous fumes, nickel carbonyl, tetrachlor-methane, formaldehyd, chromic acid, tar, glanders, compressed air or miner's diseases. It further makes clear that the disablement of an employee from an occupational disease shall be treated as the happening of an accident, according to the provisions of the act.[1]

These facts lead to the conclusion that it is only a matter of time when all occupational diseases whether "accidental" in the sense that an injury is accidental, or otherwise, will be compensable, hence the importance of taking the right attitude toward the subject and meeting the problem half way.

---

[1] *Workmen's Compensation Law*, with amendments, additions, and annotations, to August 1, 1924, pp. 39 and 82.

THE CAUSE OF OCCUPATIONAL DISEASE

The first move of the plant physician, in dealing with the problem of occupational disease, is to ascertain the possibility of its occurrence in the plant. It is clear that the plant physician must know his plant thoroughly in order to realize the possible occupational hazards. It is, however, not infrequently found that plant doctors have taken no steps to acquaint themselves with the plant and its occupational problems. Thus, when symptoms of occupational poison occur the doctor is quite unprepared to deal with them, and of course preventive measures have not even been considered.

The cause of occupational diseases may result from:

1. The physical condition of the worker
2. The existence of harmful conditions
3. The use of harmful substances

The physical examination at entrance of the new worker ensures the existence of ordinary health. It cannot determine susceptibility, which can only be ascertained by subsequent observation. The principal source of current information as to the physical condition of workers is through the day-to-day attendance at the medical department. Each malady suggests, or should suggest, a cause and, therefore, a remedy. If the doctor is persistent in his search for causes he soon comes to determine what condition or operation is harmful within the plant.

Any condition out of the normal may be considered as potentially harmful to the human mechanism. Therefore, excessive heat, light, moisture, air movement, or vice versa, may be sought for as predisposing hazards. But such hazards may apply only to a certain limited number of occupations or persons, and it becomes a duty to separate the hazardous from the non-hazardous occupations. A comparison of sickness rates between employees engaged at various occupations often indicates the difference between the two classes, the average sickness rate of the plant indicating the dividing line between the two.

Much the easiest way to detect the possibility of occupational poisoning is to ascertain what harmful substances are used in the manufacturing process. It is extraordinary but true that this obvious source of information is often overlooked. Cases have been known where lead and wood alcohol were in extensive use without their presence having been suspected by the doctor until cases of poisoning had occurred. It is not a difficult matter for the plant physician to ascertain the use of occupational poisons and then to see in what occupations they may be a danger. The purchasing department of a plant can very readily show what harmful substances are being purchased.

An industrial poison is one either used or produced in industry which may occasion unlooked for damage to the physical structure of the worker. The following is a list of the commoner poisons:

Acetaldehyd
Ammonia
Amyl alcohol
Aniline
Aniline dyestuffs
Antimony
Arsenic
Arseniuretted hydrogen
Benzine
Benzol
Carbon dioxid
Carbon bisulphid
Carbon monoxide
Chlorine
Chromium
Cyanogen
Formaldehyd
Hydrochloric acid
Lead
Mercury
Methyl alcohol
Nitro benzol
Nitroglycerin
Nitrous gases
Oxalic acid
Petroleum
Phenol
Phosphorus
Picric acid
Sulphur dioxide
Sulphuric acid
Tar
Turpentine oil

It is an easy matter to ascertain whether these or any other poisons are being used alone or in combination and the occupations with which they are associated. In this connection, a very useful pamphlet has been published by the Metropolitan Life Insurance Company.[1] This pamphlet classifies employment hazards into nine groups:

1. Extreme heat and sudden variations of temperature
2. Compressed air
3. Dampness
4. Dust
5. Extreme light
6. Infections
7. Poor illumination
8. Shock
9. Poisons

Under the headings of each health hazard are given the symptoms, condition or disease to be sought, and the occupations in which there is exposure. There is, also, an alphabetical list of occupations together with the hazards with which they are associated. Without a knowledge of the materials and processes used in a plant the list is useless, otherwise it is indispensable.

A knowledge of the existence of industrial poisons is necessary in order to be able to comply with state requirements for the reporting of deaths due to certain occupational poisons. In New York State, for instance, the law requires that, "Every physician attending any person whom he believes to be suffering from poisoning by lead, phosphorous, arsenic, brass, wood alcohol illness . . . shall send to the Commissioner a report . . . with such information as may be required by the Commissioner." The Department of Health of the City of New York, by Section 92 of the Sanitary Code, makes similar requirements. The following is a list of poisons, processes, and symptoms issued by the Department of Health.[2]

Arsenic. Arsenic, smelting, and refining of lead, tin, gold, silver, copper, zinc, mixed sulphides (practically all ores in the United States carry some arsenic); copper and brass foundries, manufacturing of arsenic compounds, color making, dye works, glass manufacturing, rubber works, wall paper, Paris green, oilcloth, artificial flowers; preserving of hides, skins, and furs, tanning and handling of hides, refining and dissolving fats and skin grease, galvanizing.

---

[1] *Occupational Hazards and Diagnostic Signs,* Metropolitan Life Insurance Company, 1 Madison Avenue, New York.

[2] *Weekly Bulletin of the Department of Health,* City of New York, August 16, 1924, p. 249.

Symptoms: Nausea, vomiting, loss of appetite, diarrhoea, local affections of eyes, ulcers of the nose, mouth, hands and feet. Multiple neuritis and paralysis of extremities.

Bisulphide of Carbon. Manufacture of carbon bisulphide, carbon tetrachloride and other chemicals; disinfectants, rubber solvents, metal polish, artificial silk; vulcanizing rubber, extraction of oil, grease and sulphur.

Symptoms: As of intoxication, loquacity, hallucinations; odor of rotten eggs on breath, profuse perspiration; dyspnea, nausea, vomiting.

Brass (Zinc) Poisoning. Brass casting, brazing, junk, metal refining.

Symptoms: Metallic taste, ague.

Carbon Monoxid. In plants where firing and heating arrangements are defective; industrial gas producing, acetylene, calcium carbide, phosphorous oxychloride, and so forth, making; mining, tunnel work; blast furnaces, gas washers, scrubbers, gas engines, gas boilers, cupolas, dolomite furnaces and other places in the steel industry, coke ovens and coal-tar distillation plants, smelting furnaces, gas machines, kilns, foundries, charcoal burning, fermentation processes, machine soldering; motor garages or testing rooms.

Symptoms: High leukocytosis, high pulse, high temperature, coma, extreme dryness of mouth and pharynx, vomiting, face red, lips may be cyanosed.

Dinitrobenzene. Explosives; chemicals.

Symptoms: Burning sensation, throbbing fullness of head, dizziness, constipation, nausea, vomiting, respiratory oppression, low blood pressure, weakness, cyanosis of face, drowsiness, coma.

Lead Poisoning. Mining and smelting of lead ores, manufacturing of metallic lead articles, lead alloys, foundry shops, tin shops, bottle cap factories, sanitary ware factories, composing rooms, file cutting works, lead colors and other lead compounds, storage batteries; babbiting, soldering, lead burning, tempering, painting and varnishing, putty polishing; in the mixing of the materials of the pottery, rubber and textile industries; linoleum manufacturing; some mirror backing.

Symptoms: Anaemia, general lassitude, loss of appetite, nausea, constipation or constipation alternating with diarrhoea, colic, blue line on the gums, wrist drop, ankle drop, defective vision.

Methyl Alcohol (Wood Naphtha). Dry distillation of wood; as a solvent in the preparation of varnish, lacquer, polish and perfumes; denaturing of alcohol, pharmaceutical preparations, coal-tar colors, in cotton print manufacturing; beer vat varnishing, artificial flowers stiffening, felt hat stiffening, aeroplane wing doping, celluloid making, patent leather.

Symptoms: Abdominal cramps, nausea and vomiting; thirst, coryza, muscular prostration, chilliness, headache, vertigo, dilation and immobility of pupils with visual disorder, blindness, pronounced dyspnea, restlessness and insomnia.

Phosphorus. In the extraction of phosphorus, manufacturing phosphorus compounds, tar colors, artificial manure, phosphorous bronze, some fireworks, in foundries, and in match factories using white or yellow phosphorus.

Symptoms: Anaemia, loss of appetite, diarrhoea, bronchitis, and gastric disorders; subacute and chronic inflammation of the bones of the jaw.

Natural Gas (Combustible Gases). Fuel gas in earth in oil regions. Accompanying petroleum borings.

"Caisson Disease." Divers, caisson workers; subaqueous tunnels, compressed air exposures.

Symptoms: Vertigo, pains in back and legs, cannot stand, "bends," complete paralysis of legs and arms, constriction of chest, subcutaneous hemorrhages.

Mercury. Smelting of quicksilver, amalgam gilding and silvering, manufacturing of thermometers, barometers, and so forth, incandescent electric lamps, electrical apparatus, compounding of salts of mercury, colors, ships' bottom paint, pharmaceutical products, dyes, explosives, felt hat manufacture, Edison iron-nickle alkaline storage battery, zinc electrodes, photography, steel engraving, priming in fuse and cartridge works.

Symptoms: Anaemia, loss of weight, general weakness, headache, loss of muscular power, salivation, metallic taste, fetid breath, sleeplessness, inflammation of gums, tremor, staggering gait.

Every plant physician should take steps to ascertain whether such poisons are being used or manufactured.

GENERAL METHODS OF PREVENTION

The protection of the worker from occupational hazards is an economic, if not a moral, necessity. If the worker's health is not protected from the ravages of industrial poisons the state steps in sooner or later, and, by means of blanket regulations, seeks to make the employer do what he will eventually find is economically and socially the best for all concerned. Athough laborers often take on dangerous jobs because they know no better, they soon find out the dangers, and ask for higher wages or quit. Men on the outside come to know the situation and thus replacement becomes difficult.

The following general measures of prevention may be considered for ordinary occupational risks. The most obvious principle of prevention is substitution for, or mitigation of, the cause, reduction of contact by dilution or abstraction, and maintenance of health by physical examination and education. These are summarized as follows:

GENERAL PREVENTIVE MEASURES

1. MATERIAL
   - (*a*) Substitution; innocuous for poisonous substances such as zinc for lead paints, gasoline for wood alcohol, tin for lead in weighting silk, tin as a bedplate instead of lead in the cutting of files.
   - (*b*) Use of insoluble instead of soluble compounds; lead glass instead of carbonate or oxide of lead in glazing.
2. PERSONAL
   - (*a*) Food
     - (1) Wholesome food at cost.
     - (2) Rooms separate from workshop for meals.
   - (*b*) Clothing
     - (1) Clean overalls periodically.
     - (2) Impervious gloves if necessary.
     - (3) Respirators.
     - (4) Head covering.

- (*c*) Cleanliness
    - (1) Mouth, nose and throat wash before meals and after work.
    - (2) Bathing on company time.
    - (3) Clothes lockers in separate rooms.
- (*d*) General
    - (1) Rotate occupations when work is dangerous.
    - (2) Determine susceptibility.
    - (3) Post rules and see they are followed.
    - (4) Give verbal instructions.
    - (5) Periodic physical examination.

3. PLANT
    - (*a*) Provide exhaust ventilation; dilute air where exhaust is impracticable.
    - (*b*) Substitute machine for hand work.
    - (*c*) Provide conveying machinery where possible.
    - (*d*) Vacuum or wet, instead of dry cleaning.
    - (*c*) Regular inspection of work places and workers.

The following recommendations, made by Dr. R. Fischer, of Berlin, seem to be so comprehensive as to merit attention:

REQUIREMENTS FOR PROTECTION OF WORKERS

1. Properly adapted buildings, thick walls of separation for dangerous rooms, good lighting, facilities for keeping the workshop clean and for effective ventilation.

2. Apparatus adapted to its special purpose, whenever possible, closing tight in every part.

3. Appliances for accomplishing the arrest of gases and dust at their place of origin, their removal (by exhaust fans), and in a suitable manner rendering them innocuous or collecting them, thus preventing them from entering the nose and mouth.

4. So far as possible, avoidance of direct contact with poisonous materials or substances injurious to health in working with, transporting, or packing them.

5. The displacement of particularly dangerous labor methods and materials by the introduction of less dangerous labor processes and materials, as well as by the employment of materials satisfactorily pure chemically.

6. Instruction of workmen just entering upon an occupation

concerning the properties of the poisonous substances extracted, manufactured, used, or otherwise evolved, and, whenever possible, caution leaflets should be put into the hands of the workers.

7. The repetition of this instruction at frequent intervals.

8. Posting of precautionary regulations and warning placards containing admonitions for the exercise of special caution and enjoining the observance of measures for insuring safety. Constant supervision of all dangerous employments by expert and responsible persons.

9. Employment by appropriate means for personal protection as work clothes, caps, gloves, goggles, and, as necessary adjuncts, mouth and nose shields, respiratory masks and the like, in case the appliances named in rule three are inapplicable.

10. Practice of bodily cleanliness by the use of wash, bath, and dressing rooms, the use of special rooms for eating, separate wardrobes for street and work clothes, and frequent, non-hazardous cleansing of the clothing.

11. Immediate report of symptoms of indisposition, attention to wounds of the skin caused by the handling of corrosive materials, the speediest employment of an unexceptionable antidot. giving promise of success at the very first symptoms of poisoning, with the simultaneous summoning of a physician.

12. The installation of a healthy working force capable of withstanding exposure to the poison. Temporary or permanent exclusion of sick workmen from the dangerous departments of the industry. Medical examination of the workers in dangerous employments at suitable intervals. Under certain circumstances there should be a change of work in occupations giving rise to chronic poisoning.

13. The utmost possible reduction of the hours of labor in dangerous employments.

LEAD POISONING

Of the hundreds of materials causing industrial disease, lead is the most destructive. It is not as virulent as other poisons but, on account of its wide use, it causes more lost time and death than all other occupational poisons together. Either as a metal, a salt of the metal, a paint, a solder, occurring as a droplet, dust, or fume it does its deadly work but usually in a slow, insidious way. "Liability to plumbism exists wherever lead is mined, smelted, wrought, handled, or used, either as a raw material, alloy, compound, or ingredient."

The metal, itself, is comparatively harmless, the dust is virulent according to fineness, and the fume is, perhaps, more deadly than any. "Where there is no dust, there is no lead poisoning," and, again, "All lead poisoning arises from the inhalation of dust or fumes." Lead or its compounds vary in poisonousness; the soluble more than the insoluble, the oxides more than the sulphates, the volatile more than the non-volatile forms. Poisoning occurs in every trade where lead is used; in refining and smelting, in pottery manufacture, in wall-paper and oilcloth, in paint-making, storage battery manufacture, in enameling, recently in the manufacture of ethylized gasoline, and in painting itself. It is easily the most frequently used industrial poison and is to be found in over a hundred different trades.

THE EXTENT OF LEAD POISONING

Accurate figures as to the extent of lead poisoning for the United States as a whole do not exist. The mortality

TABLE 23

DEATHS FROM LEAD POISONING—UNITED STATES REGISTRATION AREA

Year	Percentage of Population Covered	Number of Deaths	Death-Rate per 100,000
1910.	58.3	136	
1911.	63.1	145	
1912.	63.2	148	
1913.	65.1	162	
1914.	66.8	149	
1915.	67.1	155	
1916.	70.2	190	
1917.		147	0.196
1918.		124	0.151
1919.		148	0.2
1920.		120	0.1
1921.		142	0.2
1922.		137	0.1

TABLE 24

ATTACK RATE FOR VARIOUS INDUSTRIES

Industry	Attack Rate per Thousand	Industry	Attack Rate per Thousand
Electric accumulator	27	Paints and colors	16
White lead	26	Vitreous enameling	14
Tinning of metals	20	Metal smelting	13

statistics for the United States registration area give the figures found in Table 23, on the opposite page.

In the mortality experience of the Metropolitan Life Insurance Company for 1912-1913, out of 112 deaths from occupational poisons, lead was accountable for 81, or over 72% of the total. According to a calculation made by Austin Reiley, over 2,500 cases of lead poisoning occur in the United States each year.[1] Teleky is quoted as stating that lead constitutes 95% of all industrial cases and, in England in 1923, according to a report of the chief inspector of factories, lead poison notifications increased from 247 to 337 cases. In New York State 744 cases were reported for the 11 years ending August 31, 1922, and of these 104, or 14%, resulted in death. These cases occurred in over 50 different kinds of occupations and trades.

Variation in the rate of attack, for different industries, is shown by some English figures. In the *Annual Report of the Chief Inspector of Factories* the attack rate per thousand was as shown in Table 24, at the top of the page.

In the Massachusetts General Hospital cases of lead poisoning were diagnosed in the occupations listed in Table 25.

Certain occupations, such as interior decoration and painting, show a high incidence of poisoning. For instance, in an investigation made by the New York City Department of Health it was found that, of 402 interior decorators

---

[1] Reiley, Austin D. "The Problem of Ascertaining the Actual Rise in Mortality Caused by Unhealthy Trades," *Journal of Industrial Hygiene*, July, 1919, p. 113.

TABLE 25

CASES OF LEAD POISONING DIAGNOSED IN VARIOUS OCCUPATIONS

Occupation	Number	Occupation	Number
Painters	68	Lead	6
Shipyard	9	Plumbers	8
Navy yard	7	Miscellaneous	14
Rubber	11	Non-industrial	10
Brass foundry	4	Printers	11

and painters, 163, or 40%, showed active lead poisoning. The above figures, however, give no indication of the relative number of persons engaged in each occupation. The figures in Table 26 show the number of cases and deaths occurring from lead poisoning in England in 1923, as reported to the chief inspector of factories:

TABLE 26

NUMBER OF CASES AND DEATHS CAUSED BY LEAD POISONING IN ENGLAND IN 1923

Industry	Cases	Deaths
Electric accumulators	95	2
Metal smelting	19	2
White and red lead works	37	0
Plumbing and soldering	46	1
Printing	6	1
China and earthenware	49	11
Coachbuilding	13	3
Shipbuilding	8	1
Paints used in other industries	21	0
Miscellaneous	43	4
	337	25

A recent case, reported from Detroit, shows the occurrence of lead poisoning among 38 workers sandpapering automobile bodies. Over 60% of the total got poisoned within 8 weeks from the date of their employment; the dust was carried upwards past the faces of the men instead of downwards, by the exhaust; no respirators were used, but several thicknesses of cheesecloth were worn over the mouth and nose. In the job of sanding, 2,000 men were hired each year to keep the full complement of 200 men at work.[1]

Anything that increases the volatility of lead adds much to its danger. This appears to have been the case in the remarkable outbreak of poisoning due to the manufacture of tetraethyl lead at the Bayonne plant of the Standard Oil Company of New Jersey, on October 18, 1924. This substance, which is a compound of metallic lead and one of the alcohol series, is mixed with gasoline in the proportion of 1-1000 to lessen the speed of combustion, "knocking," and carbon deposits. At the Standard Oil plant 35 persons were affected by the poison and 5 died showing acute brain congestion.

PROPERTIES OF LEAD AND CHANNELS OF ENTRY

Lead is, generally speaking, a cumulative poison; the little particles floating in the air become absorbed and stored up in the system until there is sufficient to cause symptoms of the poison. Lead, itself, is not readily absorbed but the salts are absorbable according to solubility. Lead readily finds an entry into the system through the mouth, lungs, and skin in varying degrees. It is absorbed through the mucous membrane of the mouth and stomach, it gets into the lungs by inhalation and perhaps enters the skin through slight abrasions or by means of the pores of the exposed and perspiring skin of the scalp, face and hands, but only to a minor degree. Recent Harvard studies show that inhalation is more dangerous than ingestion since, in the former, lead compounds pass quickly into the general circulation.

Adding to the difficulties of diagnosis is the variability of reaction on different workers, possibly since the rate of elimination varies with the form in which the poison is absorbed and with the absence or presence of acidosis as pointed out by the above-mentioned Harvard investigation. This accounts for the fact that some workers have been exposed for years without visible effect while others develop symptoms within a week of starting work. Out of 100 cases of lead poisoning of painters no less than 12 had sickened within a year and, in a plant where there was no physical examination at entrance, 75% were found to be susceptible. It is evident, from the above considerations, that the avoidance of lead poisoning must be based upon a careful study of the individual and his environment. The need of team-work between the employment and medical departments in the selection, placement, and maintenance of workers is apparent.

---

[1] Dean, A. S. "Lead Poisoning in Automobile Finishing," *Journal of Industrial Hygiene*, October, 1924, p. 246.

THE SYMPTOMS OF LEAD POISONING

The doctor in charge of a labor force exposed to lead should be able to detect signs of poison at the earliest possible time. (There are many symptoms of poison which vary in extent and time of occurrence and only become palpable after the damage has been done. The occasion demands the early detection of disease by some easily discerned or readily ascertained symptom. The four cardinal symptoms for early diagnosis are said to be found in the complexion, the gums, the blood, and the urine. Pallor, discoloration of the skin, and blue gum are easy to detect, but, as Dr. W. W. Rand says, "it is a mistake to wait for such signs; it is too late."[1] The industrial physician, whose aim is prevention, must, as far as possible, anticipate the oncoming of disease, in as easy and effective a manner as possible. Examination of the blood to show basophilic granulation is, "the earliest and most constant sign of injury from lead." It is discovered in about 50% of all cases. The practice, however, is not to make blood or urine tests except in certain cases.

---

[1] Rand, W. H. "Occupational Lead Poisoning," *Monthly Labor Review*, February, 1921.

TABLE 27

SYMPTOMS OF LEAD POISON IN 2,700 CASES; ENGLAND, 1910-1914

Main Symptoms	Male Cases		Female Cases	
	Number	Percentage	Number	Percentage
Gastric......	1,853	48.1	225	46.6
Anemia.....	825	21.4	112	23.3
Headache...	303	7.8	81	16.8
Paretic......	333	8.9	15	3.1
Brain.......	53	1.4	10	2.1
Rheumatism.	293	7 6	28	5.7
Other.......	186	4 8	12	2.4

The periodic examination for lead is simple and expeditious. In England, where the percentage of deaths to cases is 7.6 as compared with 17.4 in New York, the examination, according to Dr. Burnham[1] is as follows:

> The surgeon asks one or two questions as to the general health, examines the face and conjunctivae for evidence of anemia, looks at the gums for the blue line, and tests the extensors of the fingers and the wrists for muscular weakness.

An easily applied and effective test for paresis of the arm muscles may be made by the use of the hand dynamometer both on employment and at frequent intervals. This instrument shows any decided loss of gripping power and is specially useful for hand workers. Colic, with other digestive disturbances, is believed to appear the first week of employment in the majority of cases and it is said, by Dr. Burnham, to prompt notification in England, in fully 75% of the cases. One authority claims that wrist drop is one of the most frequent pronounced symptoms, while another states he has seen it only once in 30 cases. The list on the following page is an enumeration of the principal symptoms, the occurrence of any one of which may be sufficient, in conjunction with the fact of exposure, to warn the physician to take precautionary measures, such as change of occupation or modification of conditions.

---

[1] Burnham, A. C. "The Prevention of Industrial Lead Poisoning in English Factories," *Journal of Industrial Hygiene,* June, 1923, p. 60.

1. Cramps
2. Blue gums
3. Taste in mouth
4. Headache
5. Numbness of arms
6. Pains in joints and back
7. Weakness of wrist
8. Dizziness

In an analysis made by Dr. T. M. Legge[1] of 2,700 reported cases of lead poison the symptoms listed in Table 27, on page 169, were noted in both male and female.

PREVENTION

The prevention of plumbism depends largely upon the grasp which the plant doctor has on the problem and the authority given him. Prevention begins in the employment office, where none but physically strong and mature workers should be hired. Mouth breathers, women, and youths should be excluded because of susceptibility. The use of a hand dynamometer for testing hand strength at entrance and frequently after is to be recommended, but a record of each test should be made. A doctor who knows his plant will have a fairly clear idea of the relative danger of leady jobs and this knowledge is important in placement and follow-up. Periodic physical examination should vary with the intensity and length of exposure and may be made weekly in the more dangerous jobs. "It is the only remedial measure of value."

Personal cleanliness of the worker should be insisted on, and to give force to this the employer should provide adequate facilities for washing, bathing, and changing clothes on company time. In some places individual towels, soap, and nailbrushes are provided and used. Food furnished to the employee should be wholesome and inexpensive. Two theories exist as regards the character of diet; some insist on acid drinks on the theory that they tend to eliminate lead by increasing solubility; others believe in increasing alkalinity and, thereby tending to store up lead in an insoluble and innocuous form. In a recent Harvard study of lead it is stated that inhaled lead is more dangerous than ingested lead since, in the latter case, the liver tends to eliminate the poison.

---

[1] Legge, T. M. "Twenty Years' Experience of the Notification of Industrial Diseases," *Journal of Industrial Hygiene,* 1920, p. 590.

Provision should be made to alternate occupations so as to limit exposure and without waiting for symptoms of poison to appear. Reduction of hours of work also lessens exposure and tends to maintain the health of the worker. Annual vacations with pay for workers exposed to lead should be of decided advantage.

Education of the worker in preventive hygiene should be systematic, frequent, simple, and not of an alarmist nature. It should not be limited to a mere display of rules and posters. The doctor, at frequent inspections of the workplace, may instruct the workers verbally and see that all rules are understood and obeyed.

The following instructions for the prevention of lead poisoning are issued by the Ohio State Board of Health:

INSTRUCTIONS TO EMPLOYEES: HOW TO PREVENT LEAD POISONING

1. All workers exposed to lead fumes, lead dust, lead solutions, and lead compounds are liable to poisoning. These poisons get into the body through the nose while breathing, or through the mouth when chewing, or swallowing, or wetting the lips.

2. Do all you can to keep down dust. When sweeping or cleaning, always dampen with water, oil, or wet sawdust. Where dust cannot be kept down, you must wear a respirator. This must be cleaned out at least once a day.

3. Eat breakfast before going to work. Drink milk at meals, and if possible between meals. Do not eat meals in workroom. Leave workroom at mealtime.

4. Keep dirty fingers out of your mouth, and off your food, and whatever goes into your mouth. Wash hands, arms, and face with warm water and soap before eating, going to the toilet, or quitting the workroom. Clean your lips and rinse out your mouth before eating or drinking.

5. A mustache, if worn, must be kept short. Do not wear a beard. Keep fingernails clean and cut short, also loose skin about the nails or hands.

6. Do not chew tobacco or gum while at work. Avoid the use of intoxicants in any form, as they promote lead poisoning.

7. Take a full bath with warm water and soap at least twice a week.

8. You must wear overalls and jumpers while at work. Wear a cap if exposed to dust or fumes. Do not wear your working clothes outside of the working place.

9. Keep your bowels moving, if possible, once a day. Report to your foreman if you notice (1) loss of appetite, (2) poor sleep, (3) indigestion, (4) continual constipation, (5) vomiting, (6) pains in stomach, (7) dizziness, (8) continual headache, (9) or weakness in arms, limbs, or body.

NOTE: Lead poisoning brings on paralysis of the wrists and arms, hardens the arteries, causes chronic diseases, and hastens old age and death. WORKMEN, PROTECT YOURSELF. Your employer and the Board of Health cannot do all for you. OBSERVE THE ABOVE PRECAUTIONS.

Ohio State Board of Health
Columbus, Ohio E. F. McCampbell, Ph.D., M.D.

The elimination of lead in the manufacturing processes has been found possible in some cases. It is not easy, however, to persuade some people that paints without lead are satisfactory. Many substitutes are, however, now on the market. The substitution of insoluble for soluble lead salts has been accomplished in England, which accounts for the low rate of lead poisoning in the pottery industry there, where an insoluble lead glaze is now in general use. Prevention of unnecessary contact with dust can be brought about by proper cleaning methods. The use of a vacuum cleaner is to be recommended rather than dry, or even wet, sweeping. The workrooms should be cleaned after hours by others than the regular force, thus lessening exposure. Workers should not be allowed to eat, drink, smoke, or chew in the workrooms.

Exhaust ventilation, when possible, should be installed at the point of origin. "Locally applied exhaust ventilation is the sheet anchor in the protection of the workers." In England, where this plan has been adopted, cases of plumbism have been reduced from 1,058 to 230 in 20 years. If it is impossible to move lead salts without dust, respirators should be used; but some authorities have tried them without success and, at best, they are a crude device. The Cotterell process of electrolytic precipitation has been used with some success to eliminate and recover metallic dust from the air.

The occurrence of each case of plumbism calls for immediate attention to the particular occupation involved, since the hazard varies in almost every instance. Thus, the compositor suffers from lead dust in type cases; the stereotyper inhales fumes from the dross of molten metal, and the linotyper imbibes dust from brushing the plunger.

Little has been accomplished in the prevention of plumbism in the United States. Dr. Alice Hamilton, who investigated the pottery industry in 1911, found a shocking amount of lead poisoning. In 1921 another investigation of the same industry was made by the United States Public Health Service and positive and presumptive lead poisoning was found in 13.5% of those exposed. Contrasted with a rate of 0.9% among 7,000 lead workers in England, the rate is nothing short of disgraceful. The United States leads the world—but not in the prevention of lead poisoning.

MERCURIAL POISONING

The United States is the third greatest producer of mercury, and most of it comes from California. There has been a great increase in the use of mercury in recent years; it is used in fulminate to fill detonators and, now that this demand has slackened, we are faced with a possible new hazard in the recently invented mercury vapor engine.

Mercury is a liquid practically harmless at ordinary temperatures, but its volatility increases with heat. Its salts vary in toxicity even when only slightly different in chemical composition, as in the case of the perchloride and subchloride. In the manufacturing process, the poison is slowly acquired through vaporization and condensation and less slowly eliminated. Absorption of 0.02 mg. per cubic foot daily, for two or three months, is said to cause symptoms of poison.[1] Owing to its volatile quality, a considerable percentage of those exposed are subject to the effects of the poison. In the fur cutters and hatters' trade, where mercuric nitrate is used, no less than 43% of those exposed are found to be affected.

The metal occurs in quicksilver mining, the making of hats, thermometers, explosives, and in the manufacture of its salts. In England 218 cases, occurring between May, 1899, and December, 1918, were as follows:

TABLE 28

MERCURIAL POISONING IN ENGLAND, BETWEEN MAY, 1899, AND DECEMBER, 1918 [2]

Industry	Number of Cases
Thermometers	45
Fulminate in powder factories	54
Hatters' furriers	27
Electrical meters	24
Felt hat industry	19
Chemical works	19
Water gilding	12
Miscellaneous	17

In the felt hat industry the nitrate of mercury used in carrotting constitutes a considerable danger, "It is one of the most notorious wreckers of the physique of its operators." All carrotters sooner or later contract the poison. Mercury enters the lungs as vapor or condenses on the mucous membrane in breathing, causing sore mouth, salivation or palsy, known as "hatters' shakes." Dr. Alice Hamilton says, "Industrial mercurialism as seen in hatters is slow in onset and course, and lacks some of the characteristics of more rapidly developing forms of this intoxication.

---

[1] "Mercurial Poisoning," *United States Public Health Service*, Feb., 1922, p. 336.

[2] Legge, T. M. "Mercurial Poisoning," *Annual Report, Chief Inspector of Factories* (England), 1918, p. 70.

Salivation is rare, but gingivitis is fairly common, especially at the beginning. Carrotters suffer more than others from blackening and erosion of the teeth. Tremor is the most typical symptom; erithism is not common; and there are no characteristic findings in the gastro-intestinal tract, the skin, the urine or the blood." [1]

In New York City, among 350 employees, 28% had some symptoms of the poison.[2]

Treatment consists of washing the mouth with potassium chlorate, and of baths and electricity for the nervous symptoms. Avoidance of contact is the chief preventive measure and this means the most careful control of fumes. Personal cleanliness should include frequent washing of the mouth. Smoking in the workshop is quite inadvisable on account of volatilization. Alternation of employment has been found effective. In Spain workers alternate shop work with outside work each month. This, combined with a six-hour day, has reduced cases of poisoning from 122 to 5 in 12 years. In Germany the poison was replaced by silver for mirrors and the consequent disappearance of cases. Moreover a policy of substitution has been pursued and a mixture of tannin and nitric acid is claimed to be a successful substitute for mercuric nitrate.

MULTIPLE POISONS

The existence of many different poisons in a plant should prepare the plant physician for the possibility of obscure symptoms arising from mixtures. The first way to be prepared for the situation is to study the exposure of each occupation. Each job should be associated with the poison or poisons to which it is exposed as part of the job specifications used in the employment office. But the difficulties do not end here; poisons vary in character and strength of industrial poisoning from carbon monoxid, with the percentage found in each case, are as follows: [1]

---

[1] Hamilton, Alice. "Industrial Diseases of Fur Cutters and Hatters," *Journal of Industrial Hygiene*, 1922, p. 233.

[2] *Ibid.*, p. 230.

TABLE 29

PRINCIPAL SOURCES OF INDUSTRIAL POISONING FROM CARBON MONOXID

Source	Percentage
Steel manufacture, blast furnaces	26
Making illuminating gas:	
Coal gas	5 to 8
Water gas	up to 30
Making coke (by-products)	6 to 40
Use of producer or power gas (for smelting zinc, lead, and so forth; metallurgical plants of all kinds; foundries; glass works, laundries; bakeries; brick and cement kilns; enameling porcelain; enameling sanitary ware; heating and steam-power plants)	23
Exhaust gases from motor engines	9.3
Mining explosions and mine fires	2.7 to 47.4

The acute form of carbon monoxid poisoning is known as gassing, in which a worker is suddenly overcome and left unconscious without any warning symptoms, or so few that there is not time to withdraw. Carbon monoxid acts by dissociating oxygen from hemoglobyn and taking its place. Thus a deficiency of oxygen results which, in chronic cases, brings about inefficiency and eventual sickness. When the gas is dilute there is dizziness, weakness of the knees, inclination to vomit, and unconsciousness.

In the treatment of acute cases the first step, of course, is to remove the victim from the source of poison, then to reestablish breathing and get the poison out of the system by restoring oxygen to the blood. The United States Bureau of Mines,[2] recommends the following procedure:

1. Administer oxygen as quickly as possible, and in as pure a form as is obtainable, preferably from a cylinder of oxygen through an inhalator mask.

---

[1] Hamilton, Alice, M. D. "Carbon Monoxide Poisoning," *Bulletin No. 291*, p. 25, Bureau of Labor Statistics, Washington, D. C.

[2] *Idem.*

2. Remove from atmosphere containing carbon monoxid.
3. If breathing is feeble, start artificial respiration by the prone pressure method without delay.
4. Keep the victim flat, quiet, and warm.
5. Afterwards allow plenty of opportunity for rest.

In establishing prevention it is necessary to make the worker aware of the danger, where it exists, how it acts, and how it may be avoided. The repair of all furnaces, flues, culverts, and stoves should be carefully supervised and inspected by foremen. Every workman, entering a place where carbon monoxid is likely to be present, should have a life-belt and adequate help outside. Rescue apparatus should be provided and the workman instructed as to the method of use. Before entering places for repair work they should be thoroughly ventilated and, if possible, tanks and containers should be left idle for a day or two after the source of the gas has been removed.

Acute gassing, however, causes such severe depression that the oxygen is inhaled insufficiently and thus fails to drive out the carbon monoxide rapidly. It has been discovered recently that the carbon dioxid produced in the body is the normal stimulus to respiration and, therefore, the addition of a small amount of that gas has been found to be helpful in stimulating respiration.

The subject of gas poisoning and its prevention and cure has taken on a new interest since the Great War. It is said that a thousand new gases of the most deadly kinds have been invented for use in the next war. The manufacture of these gases presents new and fearful industrial hazards. These substances are being made because they are deadly, and it is to be hoped that some of the skill lavished on their creation will reduce the hazards of manufacture.

ARSENIC

Arsenic, in the lump, is hardly dangerous unless taken internally, but it has no place in industrial operations in that form. As a salt or gas it is a deadly poison. Hydrogen arsenide, for instance, is a colorless gas which smells like garlic. Arsenic occurs in the mining and smelting of ores, in the making of arsenical insecticides, in sheep dip, tanning and in the preparation of certain colors. It is also found in paraffin refining, asphalt tar papers, tar and coal-tar derivatives. One of the most important facts for industry in general is that it occurs as an unsuspected impurity in some acids used in a large variety of industrial processes which liberate arsenic by their action on metals. Occurring thus, arsenic has a twofold danger: it is liable to poison the worker as well as the consumer. Impure acid used in the preparation of sugar from starch was the cause of the wide-spread poisoning due to "arsenical beer" several years ago in England. The acid was found to contain about 1% of arsenic. A year or two ago poison was caused in the consumption of candy due to the same kind of trouble. The acid may be pure while the metal acted on may contain arsenic. The mysterious case of poisoning in some submarines in 1916 was found to be caused by the liberation of arseniuretted hydrogen from grid castings in batteries made of an impure alloy of lead and antimony.

Poisoning in Germany from hydrogen arsenide was found to occur in the industries as shown in the following table.

TABLE 30

POISONING IN GERMANY FROM HYDROGEN ARSENIDE

Industries	Cases
Chemical and metallurgical industries	64
Laboratories	14
Making balloons	22
Toy balloons	16

Many metals, such as iron, copper, lead, and antimony, contain arsenic in varying amounts which, in industry, occur as gas, fume, or dust. Arsenic acts as a local irritant on the nose, throat, and skin. The fine powder attacks the latter particularly in those parts of the body which perspire. The poison causes giddiness, nausea, and pain in the stomach and sometimes intense thirst.

As preventive measures, apart from the usual sanitary precautions, may be mentioned the thorough and frequent use of vacuum cleaner or at least wet sweeping in the workroom. The following suggestions are made by the New York State Department of Labor:

RECOMMENDATIONS TO EMPLOYER

Provide double lockers for men engaged in Paris green manufacture.

Sweep all floors and keep ceiling and walls of workroom, hall, stairs, and lunch rooms free from Paris green dust by use of a vacuum sweeper.

Provide periodical medical examination for men engaged in the production of Paris green and Scheele's green.

Provide overalls, head and neckpieces of unbleached muslin, and gloves for Paris green workers, and have same washed weekly.

Provide clean cotton waste as respirator for all Paris green workers.

Not less than one hour should be permitted for noon-day meal.[1]

The substitution, if possible, of an innocuous substance should always be investigated in the case of such dangerous poisons. In those plants where acid or metal have to be used in manufacturing processes care should be taken to ensure purity either by guaranty from the suppliers or by chemical analysis.

NITROUS OXIDE POISON

Poison from nitrous oxide fumes is quite common in those industries where the process of nitration is carried on. With the exception of gunpowder all explosives are nitrated compounds. Nitrous oxide, which results from a mixture of nitric and sulphuric acid, decomposes on exposure to air. It is a strong, pungent, reddish, and corrosive gas, very toxic in concentrated form and liable to kill. The dilute gas is comparatively harmless. However, "The greatest single cause of sickness and death in American explosive works was the evolution of nitrous oxide fumes in the production of gun cotton and picric acid." The extent to which such sickness is caused is shown by the following:

---

[1] "Dangers in the Manufacture of Paris Green and Scheele's Green," *Bulletin Number 83*, New York State Department of Labor, July, 1917.

> In the summer of 1916, when the weather was very hot, one guncotton plant, where 300 men are engaged in nitrating, used to have about 20 men every 24 hours who had to go to the doctor with "fume sickness" but could return to work the same day or night. One carefully managed factory, where records are kept of all cases of sickness, had an average of 57 cases of nitrous fume poisoning in an average force of 600 men during each month from June to September.[1]

Mr. L. A. DeBlois, at a meeting of the National Safety Council, December, 1916, in speaking of the experience of the Du Pont de Nemours Company, said, "At our principal acid works in the most dangerous process employing 540 men in three shifts, under conditions which would have formerly been considered excellent, there were about 740 cases of fume sickness reported in the month of March and April, 6 of which were fatal.

In 28 plants in one year, Dr. Alice Hamilton found as many as 1,389 cases and 28 deaths from nitrogen oxides and nitric acid, and 13 plants could not be included for lack of information.[2] It is axiomatic that where statistics are not kept conditions are worse than in the worst plant where the facts are known.

Nitrous oxide is evolved from the mixture of nitric and sulphuric acids as part of the nitration process. The gas given off is pale yellow which rapidly changes to a deep orange color on exposure to air. In the manufacture of explosives decomposition is often violent, resulting in the escape of some of the fumes into the working spaces; pipes or still doors leak or the stoppage of a pipe causes a break in confined areas where the men are at work, thus exposing them to the action of the fumes.

---

[1] Hamilton, Alice. "Industrial Poisons Used or Produced in the Manufacture of Explosives," *Bulletin Number 219*, p. 17, Bureau of Labor Statistics, Washington, D. C.

[2] *Ibid.*, p. 13.

The gas corrodes and irritates the lining membrane of the lungs from which congestion, bronchitis, or pneumonia follow, according to the length and strength of the exposure and gas. It is believed that the worker becomes tolerant to small doses, very quickly, but, in the severer cases, "The worker, after having been gassed, is able to go on with his work for three or four hours, when he finds that his breath is becoming short and he has, perhaps, difficulty in getting home. Later on he develops bronchitis or pneumonia. Longer exposure than two minutes in a building where there has been a sudden escape of fumes which envelop the workman will cause death from suffocation. If exposure lasts only from one-half to nearly two minutes, he may rapidly recover on being removed to the open air and soon feel as if the danger were over, but in these cases congestion of the lungs follows."[1]

In the milder cases nitrous fumes cause slightly inflamed mouth and throat with cough and difficult breathing.

In occupations subjected to such fumes as nitrous oxide it is advisable to exclude mouth breathers and those with weak lungs. Negroes, on account of their tendency to tuberculosis, should not be employed in nitration works. Frequent inspection of the condition of nose and throat of workers is advisable, and, since gassing tends to weaken the lungs, alternation of employment or transfer to another occupation may be worth while. Not only is ample ventilation of the workplace imperative, but there should be large and convenient exits where the emission of gas is a possibility. The Du Pont de Nemours Company provides ample window space, large monitors, and air change at the rate of 50 times per hour where cotton is nitrated.

---

[1] Legge, T. M. "Industrial Poisoning in the Manufacture of Aeroplanes, Explosives, and Dyes," *Journal of Industrial Hygiene*, August, 1920, p. 124.

An airplane propeller is provided which can be switched on from the outside in case of emergency. Men show little desire to wear respirators, but one of aluminum damped with a weak solution of caustic potash has been found effective. The following instructions are issued to all:

NITROUS FUMES

1. Workmen are warned against breathing brown acid fumes.
2. Always put on the air helmet before repairing leaks or entering, or remaining in, a part of the room heavily charged with the fumes.
3. The fumes, if breathed, may cause shortness of breath some hours later and lead to serious illness.
4. If these symptoms develop at home, send at once for a doctor, and meanwhile keep in the open air as much as possible.
5. If they develop at the works, send at once for the doctor. Pending his arrival, the right treatment is to:
    - Make the patient lie down.
    - Keep him warm.
    - See that he has plenty of air.
    - If he is blue in the face, administer oxygen; and, if he has not been sick, give a drink of an ounce of salt in ten ounces of lukewarm water, and repeat the dose until he is sick.
6. Keep the air helmet in good repair and handy, as you never know when you may want it.

BENZOL POISONING

Benzol (Benzene) C_6H_6, derived from the fractional distillation of coal-tar, is one of its first and most volatile distillates. It must be distinguished from a mixture of the same name, and Benzine which is made from petroleum. Benzol is the raw material from which picric acid, phenol, and aniline are made. It is a colorless, highly volatile, inflammable liquid and one of the important industrial poisons, since it takes only a small quantity to poison or kill. Some people are specially susceptible, and women more than men. A quarter of a gram per litre is said to produce listlessness and confusion.

In the United States there has been a great and, perhaps, permanent increase in the manufacture of benzol in the last decade. The extent to which it poisons is hardly known, since many cases are unrecognized and unrecorded, but the percentage of fatalities to reported cases is higher than for almost any other poison in industrial use. Dr. Alice Hamilton gives statistics from 28 plants in 1915-1916 showing 14 cases and 7 deaths.[1] In Massachusetts there were five fatal cases in three years in the rubber industry.

Benzine is used in the rubber industry as a solvent, and in many other industries in a small way as a rubber cement, as also in the manufacture of carbolic acid, aniline dyes, and in the preparation of certain drugs, in dry cleaning and the coating of leather substitute. It occurs also in the composition of many secret preparations with fancy names the nature of which is unknown to the user.

Poisoning is caused by inhalation of the fumes which occur in the process of manufacturing or in the use of solvents. It may be absorbed through the skin on account of its fat dissolving power. The principal danger occurs in the repairing of pipes and the cleaning of stills and containers the metal of which seems to absorb benzol and retain it even after thorough washing and ventilation.

In the inhalation of moderate quantities of benzol there is giddiness, excitement, confusion, and vomiting, followed by nervous twitchings. Concentrated vapor brings death suddenly, with little intervening stupor. An early sign of chronic poisoning is irritation of the mucous membrane and bleeding from the gums and nose accompanied by blue spots on different parts of the body, resulting from rupture of the blood vessels under the surface of the skin. "Hemorrhage from mucous membrane of gums and nose is an early symptom and one that may safely be used as a guide in excluding from work." Aplastic anemia is said to be a most important symptom.

---

[1] Hamilton, Alice. "Industrial Poisons Used or Produced in the Manufacture of Explosives," *Bulletin Number 219*, p. 13, Bureau of Labor Statistics, May, 1917.

In general it is a good policy not to hire or keep persons who show any predisposition to the conditions produced by the poison, in this case kidneys or heart. Females, "bleeders," and alcoholics should also be excluded. Particular effort should be made to inform the worker of the dangers of benzol poisoning and all repair work should be carefully supervised. There should be adequate general ventilation, in one case no less than 57 changes per hour were found to be necessary, since only a small quantity may cause unconsciousness. In the second progress Report of the Sub-Committee on Benzol, Chemical Section of the National Safety Council, issued in 1925, it has been pointed out that, "Local exhaust ventilation at the point of origin of vapors appears to be a highly efficient procedure for avoiding benzol poisoning, no abnormal blood counts having been observed in workrooms provided with this protection." Where possible benzol may be replaced by solvent naptha, or some other less powerful poison. Physical examination is advisable every month.

The manufacture of dyes is increasing rapidly in the United States and, during 1923, over 93 million pounds were produced. Since dyes result from the action of various acids and alkalis on benzol and other coal-tar products complex hazards result. Thus there are dangers from nitric and hydrochloric acids, from derivatives even more toxic than their constituents, from caustic soda, and from arsenic.[1]

ARTIFICIAL RESPIRATION

The process used to resuscitate unconscious persons is called artificial respiration. The worker in industry is liable to several dangers which, without warning, may check respiration and stop the heart. Among these are gas poisoning, electric shock, and drowning, in each occurrence of which there is one supreme need—that of restoring normal breathing at the earliest possible moment.

---

[1] Hamilton, Alice. "Industrial Poisoning in Making Coal-Tar Dyes and Dye Intermediates," *Bulletin Number 280,* Bureau of Labor Statistics, Washington, D. C., 1921.

There are two types of artificial respiration: the positive and negative. In the first kind, instruments such as the lungmotor and pulmotor are used to inflate and deflate the lungs alternately. It is difficult to have such instruments at hand in an emergency and to apply them with sufficient expedition, since persons must be trained to use them. In addition, it is claimed that the process of inflation is more complete than deflation but, in any case, neither follows the ordinary physiological process. These objections are sufficiently strong to make it necessary to find a simpler, more easily learned and universally applicable method.

This is found in the Schafer method of prone pressure which is now coming into general use because it can be applied immediately and kept up continuously by a single person after a small amount of instruction.

The prone pressure method of resuscitation may be applied by taking the following steps:

1. Begin operations immediately.

2. Send some one else for a physician.

3. Loosen clothing around the throat if it can be done quickly.

4. Lay victim on stomach, face sidewards, with arms extended forward.

5. Remove gum, tobacco, candy, or false teeth from the mouth, drawing tongue forward.

6. Kneel astride the body below waist facing head. Place palms of hand on sides and small of back just above the hips and over the lowest ribs.

7. Bend slowly forward, with straight arms on the ribs, gradually and fully, and repeat the operation 12 or 15

times a minute by swinging back and forth rhythmically every 5 seconds.

Patients should get the fresh air and be kept warm. Even after revival they should be kept lying down to ensure full recovery.

In electric shock the heart action may be suspended before respiration is arrested and the prone pressure method tends to stimulate the heart. Counter-shock as a means of resuscitation following electrocution, is not favored by those best qualified to judge—the medical profession. "The cause of death in electrocution is ventricular fibrillation. In place of carrying out its proper beat the whole heart goes into a state of fibrillar contraction. The only method of resuscitation which can be usefully employed by a layman is Schafer's method of artificial respiration." [1] When a gassed patient is breathing he should not be given artificial respiration unless the breathing ceases. Oxygen inhalation, with the addition of 5% of carbon dioxide, increases the respiratory volume and may be applied by the special apparatus recommended by Henderson and Haggard.

The outstanding advantages of the prone pressure method is that it can be taught easily and administered easily by a single person, and, since no apparatus is required, work can begin without delay.

A striking evidence of the value of teaching this simple method of resuscitation is shown by a recent case. Stanley V. Schultz, night chauffeur of the Commonwealth Edison Company of Chicago, saved the life of an employee of the Western United Gas and Electric Company, on Sunday, August 10, 1924.

Late Sunday afternoon Mr. Schultz was driving in Westmont, Illinois. The victim of the accident was engaged in making a service tap on the gas main running along the street. Sunday work was necessary owing to the rapid development of the subdivision. Failing to make the connection with the main soon enough, the employee was overcome by escaping gas just before Mr. Schultz arrived on the scene.

---

[1] Campbell, Argyll, and Hill, Leonard. "Counter-Shock as a Method of Resuscitation Following Electrocution," *Journal of Industrial Hygiene*, November, 1924, p. 267.

Aided by the foreman, he carried the victim to the sidewalk, and began working on him immediately. It was impossible to send the foreman for a doctor, or assistance, as he was unable to speak English. After a half-hour of patient, careful work on the part of Schultz, the asphyxiated patient regained consciousness.

"I learned the prone pressure method while in the Overhead Division of the Street Department," Mr. Schultz said. "Practical instruction in resuscitation was a regular part of our Monday's work. I am glad to have been able to help. You can never tell when things like that are going to happen."

XI

OCCUPATIONAL DUSTS

Their prevalence in industry. Classification; organic and inorganic dusts. Occupational exposure. Tuberculosis and dusty occupations Death-rates. Prevention methods. Occupational skin diseases. Extent and prevention. Anthrax. Prevalence, treatment, and prevention.

No air is so pure that it does not contain dust. Where there is movement, as in all manufacturing processes, the amount of dust increases considerably beyond that which humanity is accustomed to breathe. Dusty air is not always apparent, in fact the destructive atoms are often so small as to be invisible to the naked eye. Dust is matter, of many varieties and shapes, in a fine state of subdivision, the deleterious action of which depends mainly on its chemical but somewhat on its mechanical action. According to a recently published English work, the inhalation of dust "plays a most important part in causing occupational sickness and mortality, exceeding in the extent of its effects in the community those produced by any other single injurious agent or condition." [1]

The lungs of the worker need pure air for full health and strength, while dust weakens and predisposes him to a variety of disorders. The importance of health preservation in this respect is emphasized by a study of plant sickness records where it is found that the preponderating ailments are respiratory in character. Winslow and Greenburg say, "In certain trades and occupations we find a definite condition—the presence in the atmosphere of fine particles of mineral and metallic dust—so clearly associated with an enormous excess of respiratory mortality as to leave no reasonable doubt that the dust is the effective factor in causing the diseases."[1]

---

[1] Hope, E W., Hanna, W., and Stallybrass, C. O. *Industrial Hygiene and Medicine,* W. Wood & Co., New York, 1923.

As a consequence we find, in occupations afflicted with dust, workers dying from 10 to 20 years before they otherwise would and thus the employer loses a vast amount of stored-up knowledge and skill.

The word "dust" is simple but not the elements of which it is composed nor the troubles which result from inhalation. Dust varies in chemical and physical composition and produces effects as varied as its character. Although dust is seldom of unmixed composition the action of different kinds is sufficient to make itself felt in the death-rate of those subjected to them. Lead is a dangerous poison, but it is far less a significant factor in the death-rate than tuberculosis which results from non-poisonous dusts. Though some dusts are comparatively harmless, others are actually foes to industrial life. Their variety may be seen by the following classification:

Inorganic Dusts:
    Metallic, such as steel, brass
    Non-metallic, such as silica, lime, soda

Organic Dusts:
    Animal, such as fur, hair, bone, wool
    Vegetable, such as hemp, cotton, wood, starch, flour
    Mineral, such as coal

These dusts vary in size, shape, hardness, and solubility and, therefore, in their effect on the human organism. They may be corrosive, cutting, poisonous, obstructive or infective. According to Collis, they are more injurious as their chemical composition differs from that of the human body or from elements of which the body is normally composed. Thus, lime, and the carbon in coal, which are normal body constituents, are found to be comparatively harmless.

---

[1] Winslow, C. E. A., and Greenburg, L. "Industrial Tuberculosis and the Control of the Factory Dust Problem," *Journal of Industrial Hygiene,* 1920, p. 333.

The occupations exposed and the dusts with which they are associated are shown in the following:

Nature of Dust	Occupations Exposed
Metallic dusts:	Grinders, polishers, printers
Mineral dusts:	Stone, marble and cement workers, plasterers, core makers
Vegetable fibers:	Spinning, weaving, jute, paper and hemp manufacturing
Animal dusts:	Furriers, hatters, woolen and carpet manufacturing
General organic:	Flour milling, starch manufacturing, tobacco and snuff, leather tanning and shoemaking

The two main classes of dusts differ somewhat in behavior. Inorganic dusts, metallic and non-metallic of all kinds, affect the lungs but differ in the severity of their action according to their physical and chemical character. Free crystalline silica, found in quartz, granite, flint, and sandstone, is, perhaps, the most dangerous, while lime, plaster of Paris, and soot are only harmful after long exposure.

Organic dusts, both animal and vegetable, are much less harmful since many of them are soluble in the bronchial secretions and do not differ materially from the elements of which the body is composed. Yet, respiratory diseases occur in the industries where such dusts are found. The dusts act, first by clogging up and reducing the efficiency of the lung and thus lessening vital resistance, and, secondly, by acting as carriers for the tubercle and other bacilli.

"While there are a number of dusts which do more or less harm, silica is the only one which has been found to be a serious occupational hazard."[1] Silica is a danger in grinding or sand-blasting and there are many large plants where at least some workers are exposed to these hazards. Workers may be protected from, but never cured of, the ravages of silica. Silicosis, a fibroid phthisis, results from the inhalation of silica dust.

---

[1] Britton, J. A. "Silicosis, a Modern Health Hazard," *Journal of Industrial Hygiene,* Vol. VI, No. 5, September, 1924, p. 199.

No very positive statement can be made as to the number of workers exposed to the dust hazard but, in round numbers, they are probably 10% of the whole. All employees, of course, breathe in more dust than is found elsewhere, but, even in plants the amount and character of dust are variable from time to time and differ with the process, both in weight and number of particles per cubic foot. Winslow and Greenburg show this variation in a tabulation of several investigations in which the average particles of dust per cubic foot are 103,000 in cigar shops and 159 millions in an abrasive factory. The weight of these particles varied from 0.0001 mg. per cubic foot in a pearl button factory to 55 mg. per cubic foot in a sand-blasting chamber.

Table 31, compiled from the *Report of the Census on Occupation Statistics,* 1910, shows the number exposed to occupational dusts.

TABLE 31

AMERICAN WAGE-EARNERS EMPLOYED IN DUSTY INDUSTRIES, TRADES, AND OCCUPATIONS [1]

Trade Group	Males		Females	
	Number	Percentage	Number	Percentage
Metallic dusts	258,454	7.9	33,255	4.9
Mineral dusts	514,693	15.8	15,332	2.3
Mineral industries	844,897	25.9	550	.1
Vegetable fiber dust	336,323	10.3	296,135	44.0
Animal and mixed fiber dust	183,937	5.6	149,262	22.2
Organic dust	531,911	16.3	177,545	26.4
Mixed organic and inorganic (public)	594,285	18.2	1,399	.2
Total	3,264,500		673,478	

Figures showing the death-rate of workers in dusty occupations as compared with that of all occupied males in the same age group indicate a considerably higher percentage for the former in Table 32.

---

[1] Hoffman, F. L. "Mortality from Respiratory Diseases in Dusty Trades," *Bulletin No. 231,* Bureau of Labor Statistics, Washington, D. C., June, 1918.

TABLE 32

RATIOS IN PERCENTAGE OF TUBERCULOSIS DEATHS TO TOTAL DEATHS IN OCCUPATIONS EXPOSED TO MINERAL AND METALLIC DUSTS—UNITED STATES REGISTRATION AREA [1]

Occupation	Age Death-Rate Groups	
	25-34	35-44
All occupied males	30.9	24.0
Iron and steel workers	26.1	23.3
Plasterers	31.5	34.5
Tinplate and tinware workers	36.7	34.8
Glassworkers	42.6	33.1
Marble and stone cutters	43.5	44.1
Printers, lithographers, pressmen	50.0	36.3

The figures in Table 33, comparing industrial and non-industrial occupations, emphasize, if not the effects of occupational dusts, the tuberculosis to which certain workers are exposed.

TABLE 33

MORTALITY FROM TUBERCULOSIS IN CERTAIN OCCUPATIONS IN THE REGISTRATION STATES, FOR THE AGES OF 10 YEARS AND OVER, 1900 [2]

Occupation	Deaths per Million
Marble and stone cutters	540.5
Cigarmakers and tobacco workers	476.9
Compositors, printers, and pressmen	435.9
All occupied males	*236.7*
Farmers, planters, and farm laborers	111.7
Lumbermen and raftsmen	107.1
Bankers, brokers, and company officials	92.1

The above figures indicate very clearly that certain occupations are unduly hazardous. Workers in these industries

---

[1] Winslow, C. E. A., and Greenburg, L. "Industrial Tuberculosis and the Control of the Factory Dust Problem," *Journal of Industrial Hygiene*, 1920, p. 337.

[2] *Ibid.*, p. 340.

tries die before their time and have to be replaced by other workers who die before their time, and so on. They suffer from dust in the transposition of raw material to finished product, of grain to flour, in the abstraction of coal and metal from the ground and in the preparation of many mineral, animal, and vegetable substances.

Dust injures the worker in several ways. It is inhaled into the lungs and, to a lesser degree, swallowed with food and drink, and absorbed whenever the mouth is open. A few dusts injure by their caustic action on the skin. If dusts do not actually cause certain diseases they make persons more susceptible. The chief diseases resulting from dust are respiratory, of which tuberculosis, bronchitis, fibrosis, and asthma are the commonest forms. Tuberculosis, that scourge of humanity, results, generally indirectly, from quarrying, grinding, and cutting in so far as these operations are subject to predisposing influences. Some dusts, such as coal and cement, are almost harmless by themselves. The presence, however, of free crystalline silica makes an otherwise harmless dust dangerous. Rough dusts, such as steel and silica, first inflame the breathing apparatus and then the lung becomes a fertile ground for tubercle bacilli. The dusts which find their way into the digestive tract are mainly harmful in proportion to their poisonous qualities, and the resulting malady varies with the nature of the dust.

The first apparent sign of trouble, for which the plant physician has to watch, is coughing and sneezing which announce that the organism is using nature's way for expelling the foreign matter. Then follows hard breathing, the symptom of an inflamed condition of the respiratory tract and a clogged condition of the lungs. When such a stage is reached it may be too late to adopt curative measures, but it is certainly time to consider the question of prevention more seriously. In no disease, to which the industrial worker is subjected, is the policy of prevention more vitally valuable.

THE PREVENTION OF OCCUPATIONAL DUSTS

Dust may be obviated, reduced, or controlled by some of the following plans:

1. Elimination of the process which causes the dust
2. Substitution of an innocuous for a dangerous dust
3. Alteration of process so as to reduce the amount of dust
4. Control of process by:
    - (*a*) Enclosing sources of dust
    - (*b*) Exhausting the air that contains dust
    - (*c*) Diluting the volume of dust by the influx of pure air
    - (*d*) Protecting the immediate air supply by respirators
    - (*e*) Supplying the worker with pure air by means of helmets
    - (*f*) Reducing the volume of dust by damping or wetting

Dust may be reduced or diluted by washing or spraying the air on entrance into the workroom, by the substitution of wet for dry grinding, or by smoothing oil-painted surfaces with wet instead of dry sandpapering or pumice. However, it should be remembered that damping only protects as long as the substance remains moist, and provided it does become moist which, in some instances, seems to be doubtful. "As a matter of fact, the spray which comes from a wet grindstone carries the dust with it and not only does the dust seem to be as readily inhaled when moist as when dry, but the moisture in the sandstone grinding seems to be an additional hazard to the operator." [1] In the manufacture of poisonous substances, such as lead salts or arsenic, the housing of the mixing, sifting, or conveying apparatus is desirable. Such structures must be tightly closed to be effective. In such processes as grinding, exhaust systems at the point of origin are the best. To be effective the place where the dust occurs must be covered as completely as possible by hoods so that the suction will be effective without interfering with the work. If the worker cannot be protected by such methods the use of respirators must be considered. Many of these devices are ineffective in themselves and also because the workers object to wearing them, and besides they reduce efficiency. In the sandblasting process Winslow found the use of a helmet, with a positive supply of fresh air, to be very effective.

---

[1] Britton, J. A. "Silicosis, a Modern Health Hazard," *Journal of Industrial Hygiene,* Vol. VI, No. 5, September, 1924, p. 199.

The National Safety Council has issued *Safe Practices Pamphlet Number 64,* which gives information on the use of respirators, gas masks, hose masks, and other breathing apparatus. The home-made respirator, a piece of muslin 33 inches long by 5 inches wide, with absorbent cotton as a filtering medium, has been found more effective and cheaper than other varieties.

Workers, themselves, feeling no immediate inconvenience from the hazards of dusts, are often unaware of the danger. The Ohio State Board of Health issues a poster as follows:

INSTRUCTIONS TO EMPLOYEES IN DUSTY TRADES

1. Don't breathe dust of any kind—it causes colds, consumption, and pneumonia.
2. Don't sweep during working hours—it spreads germs of all kinds.
3. Don't work in dusty air. Stop the dust or wear a dust protector over your mouth and nose.
4. Dust breathed into your lungs is never breathed out again.
5. If you breathe dust you are bound to cough.
6. Coughing or spitting is nature's warning that your lungs are in danger.
7. If you hem or cough every day see a doctor at once.

Such preventive measures have, on the whole, justified themselves. The introduction of machinery, as in the suction of grain, instead of shoveling, not only secured a quicker and more economical process but it eliminated a serious dust hazard. There may often be a double advantage in mechanical dust removal; for instance, values may be recovered, as in the case of gold and silver manufacture; sawdust may be recovered for fuel; or a hazard may be removed, as in the case of flour and starch. Moreover, the removal of dust prevents the injury of the bearings and working parts of machinery just as it does in the case of the worker.

OCCUPATIONAL SKIN DISEASES

Occupational skin diseases are minor, though not infrequent, time losers and efficiency reducers. A preponderating number of them attack the hands and thus effectively cause the worker to go slow whether he is disposed to do so or not. Hence, although seldom leading to fatal consequences, they are a factor to be reckoned with in industrial medical work. Another thing which is worthy of note is that such maladies are coming gradually under the provisions of workmen's compensation acts as compensatory.

Most of these skin inflammations arise from the abnormal conditions found in industrial operations. If there is heat in the process, or even in the weather, the moist condition of the skin resulting from perspiration provides a lodging place for dust which may be harmless in a dry state but which, when wet, sets up an irritation. On the other hand, cold weather, and cold and wet processes retard circulation, from which results a predisposition to disease. In general, however, all dusty processes tend to clog the pores of the skin; irritation ensues, scratching results, the surface of the skin is broken and hence bacteria enter.

The worker, himself, is often responsible for the prevalence of skin disease which he is as likely to bring in to the plant as to acquire on the job. This is of importance to the employment manager and to the plant physician alike. There is the problem, too, of individual susceptibility. Some workers are immune while others show abnormal sensitivity. This condition can only be surmised in the case of a new employee if there is no previous history of skin disease. It may be noted, also, that compensation is not payable to workers, under the compensation act of New York, if they have been previously afflicted.[1]

Blonds, by common report, have sensitive skins and are more vulnerable than brunets. Dry skins are more susceptible to infection than moist skins, since dryness breaks the skin. On the other hand, persons with oily skins, such as the negro, are more immune to attacks from alkalis, certain metallic salts, and benzol.

The immediate causes of industrial skin diseases have been classified as follows:

1. Parasites, found in raw material both vegetable and animal.
2. Infections, from which result boils, eczema.
3. Mechanical causes, such as pressure on the skin, abrasions.
4. Chemicals, which act as caustics or dissolve the protecting skin grease. "In order of frequency trade rashes are caused by alkalis, lime, chrome, coal and petroleum products, sulphide of sodium, and arsenic.

Lice and bedbugs are occasionally found among workers and, getting into the plant, infest others. The worker scratches himself with dirty fingers and the result is often an infection. In all industrial operations where hands are used frequently minute breaks in the skin are apt to occur the evidence of which is demonstrated by steeping the hands in alcohol or dilute acid whereby stinging sensations result. Such breaks, invisible to the naked eye, are sufficient entry for micro-organisms which bring about infections such as boils and oil rash, to which machinists and lathe hands are particularly subject.

Many skin troubles result from the process of manufacture. Continuous steeping of the hands in acid or alkali makes them sensitive. In the machining of metal sharp minute particles enter the skin and set up irritation. Strong soap, hard brushes, naphtha to clean the hands make the

---

[1] New York State Workmen's Compensation Law, amended to August 1, 1924, p. 83.

TABLE 34

OCCUPATIONS FOUND IN A LIST OF 621 SKIN DISEASES

Occupation	Number
General laborers	59
Iron and steel workers	36
Colliery workers	32
Mill workers	26
Chemical workers	25
Rubber workers	24
Bakers	16
Printers	12
Leather workers	6
Linoleum workers	4

skin tender. Baker's itch is probably in part due to the clogging up of the pores during work.

The injuries from chemicals are as varied as the substances themselves. Some burn, some irritate, while pitch, tar, paraffin, creosote oils are apt to cause local irritation and even cancer. Benzol and allied substances act like alkalies as solvents of the natural grease of the skin, laying the latter bare to infection.

Because of the minor disabilities caused, we are apt to overlook their importance in the aggregate. The worker loses little time in absence; he is much more likely to keep on the pay-roll while working at reduced speed and the lowered output becomes a substantial though unrealized loss. A man with an ulcer on his thumb can hardly help going slow.

Perhaps one-fifth of all skin diseases have an occupational origin,[1] and when one considers that many industries are almost free from this type of ailment it is obvious that some must have quite a high percentage. White found no less than 46 different well-known skin diseases in 120 different occupations. In some plants making binder twine no less than a quarter of the workers were affected by some form of dermatosis.

---

[1] Cole, H. N., and Driver, J. L. "Industrial Dermatosis," *Journal of Industrial Hygiene,* February, 1923, p. 425.

Skin diseases are usually associated with occupations subject to dust or poison. The dye worker is pestered with eczema and the fur dyer with ulcers. In a list of 621 skin diseases the occupations given in Table 34 were found.

In England the cases reported to the chief inspector of factories and workshops, for 1923 were as follows:

TABLE 35

CAUSES OF INDUSTRIAL SKIN TROUBLE IN ENGLAND IN 1923, AS REPORTED TO THE CHIEF INSPECTOR OF FACTORIES

Causes	Number
Dyes and their intermediates	24
Alkalis, caustics, and acids	15
Turpentine	14
Volatile liquids, spirits, polishes, and so forth	11
Flour, sugar, and so forth	9
Wood dusts	6
Lime and calcium compounds	3
Miscellaneous	13

Metal workers are particularly subject to a bacterial infection due to the use of lubricants and cutting oils. These substances become dirty through constant use, the worker's skin becomes clogged at the hair roots and inflammation results; or, the small particles of metal in the oil puncture the skin and thus expose it to bacteria, which are always present on its surface. The result is an epidemic of boils. McConnell found, in a study of industry in Chicago, Minneapolis, and St. Paul, that no less than 27% of 2,060 workers suffered from skin troubles due to the use of oils and lubricants, and Hayhurst records no less than 2,000 cases of dermatitis in Ohio between August 4, 1921, and December 31, 1923, many of which were due to cutting oils.[1]

Personal cleanliness is a palpable need in the prevention of industrial skin diseases. The principal prophylactic measure is to keep the surface of the skin in good condition by exercise and bathing. Where cutting compounds are used, the application of lanoline after washing serves to keep the skin pliant while flexile collodion or compound tincture of benzoin should be used to protect abraided skin. Where materials such as benzol are used, gloves or an impenetrable varnish protect the skin. If benzol can penetrate the gloves they had better not be used.

---

[1] Hayhurst, E. R. "Status of the Occupational Disease Question in Ohio," *Journal of Industrial Hygiene*, October, 1924, p. 259.

In plants where there is any danger of skin disease the employer should provide ample washing and bathing facilities with a plentiful supply of towels and soap, and some one should see that the worker uses them. Overalls, saturated with oil, cause outbreaks of disease and it may be advisable for the employer to have them washed once a week. In the shop the foreman should inspect the condition of the skin of the worker and the conditions of the workplace itself. Such measures, faithfully followed, will reduce, if not eliminate, the larger proportion of industrial skin trouble.

ANTHRAX

Anthrax is a virulent disease, fortunately not common in industry. It is, however, increasing and, owing to its fatal character, needs attention in those industries to which it is peculiar. Anthrax is transmitted to man from animal matter, such as hides, skins, wool, or horsehair, in which anthrax spores exist. They float around in the dust attendant on handling and lodge sometimes in the broken skin, causing a local affection of great virulence; the onset is sudden and the spread rapid. There are two types, of which the external is by far the most common in industry. It is caused by a tiny rod-shaped bacillus which multiplies rapidly.

For the 6 years ending 1922 there have been 261 deaths in the United States Registration area. In England, for the 4 years ending 1918 there were 374 cases and 51 deaths. In the state of New York, in the space of 12 years there have been 91 cases and 16 deaths. Pennsylvania reports 20 cases of anthrax of industrial origin in 1922 and the average number of days lost by those who recovered was 56.5 days per case. In Massachusetts there were 64 cases and 20 deaths between 1907 and 1915 inclusive.

In England, of the industrial cases reported, from 1899 to 1922, 52.4% of the total occurred in the woolen industry; 28.1% from hides and skins; 13.7% from hair and bristles, with a mortality rate of 18.7%.[1] In Pennsylvania, nearly 70% of all industrial cases occurred in the tanning industry, and nearly 15% in the hair industry in 1922. The rate of infection is highest among laborers and handlers of dry skins in the cattlehide tanneries.

The ratio of cases to deaths in Massachusetts over an 8-year period was 31.2%. In England, over a period of 4 years the rate was 15%, as shown by the following figures:

TABLE 36

NUMBER OF CASES AND DEATHS CAUSED BY ANTHRAX IN ENGLAND, 1914-1918[2]

Industry	Cases	Deaths
Wool	242	31
Horsehair	20	6
Hides and skins	94	11
Other industries	18	3
	374	51

TREATMENT OF ANTHRAX

The most essential feature in treatment is promptness. It is, therefore, imperative, in exposed operations, that the employer should, in every case of absence, determine the cause immediately, and have a doctor proceed with curative measures at once. "In general, the best treatment for a case of anthrax is physiological rest of the affected part, with intravenous injection of 60-80 cc. of anti-anthrax serum, followed by 60 cc. on the following day."[1] Surgical treatment is not now generally recommended, the mortality rate being much higher than in the cases treated with serum alone. In a recent study of 123 cases in Pennsylvania, however, serum was used alone in 5 cases of which 3 proved fatal, possibly because treatment was delayed. In Massachusetts, 4 of 9 patients treated surgically died; only 3, treated non-surgically, died.[2]

---

[1] "Anthrax in the British Empire," *International Labor Review*, February, 1924, p. 242.

[2] Legge, T. M. *Anthrax*. Lowell Institute Lecture, Dec. 11, 1919.

In a recent investigation by Dr. William Jacobsohn, industrial medical inspector of the New York City Department of Health, of 61 cases of human anthrax occurring in New York City between 1919 and 1923, he concluded that, "The administration of anti-anthrax serum alone without the aid of incision, excision, or cauterization gave in the greatest number of cases the best results."[3] It appears to be quite apparent from the above evidence that the early application of anti-anthrax serum gives the best results when administered promptly, and this hinges on the maintenance of supervision over absentees.

PREVENTION OF ANTHRAX

Removal of the cause is the first course that suggests itself. This involves disinfection of the hides, hair, or material in which the spores exist, but this is almost impossible where the sources of infection are so widely distributed. In Liverpool, however, a wool-disinfecting station has been established where the wool is first washed and afterwards steeped in a formaldehyd solution. Usually the prevention of anthrax resolves itself into the issuance of rules, the avoidance of dust and, above all, the protection of abrasions however slight, from infection. All pimples, boils, local inflammations should be reported to the doctor promptly. Instruction to workers may be as follows:[1]

---

[1] Hope, E. W., Hanna, W., and Stallybrass, W. *Industrial Hygiene and Medicine.* William Wood & Co., New York, 1923, p. 337.

[2] Scholl, Albert J. "Anthrax," *Journal of the American Medical Association,* May 22, 1920, p. 1441.

[3] *United States Public Health Reports,* October 3, 1924, p. 2523.

NOTICE TO WORKERS

1. Use soap, water, flesh brush, and towels liberally.
2. Rinse your hands in bucket of disinfectant before drying on towels.
3. Give special attention to fingernails; always keep them short and clean.
4. Do not scratch or pick any broken surface of the skin.
5. Report to office any form of sickness, cuts, accidents, bruises, pimples, sores, for immediate attention.
6. See that dressing rooms, washbasins and toilets are kept clean, and report to foreman any violation of rules for your own protection.
7. Caution all new employees.
8. Working gloves may be obtained at the office.

In addition to such rules it is important to insist on shop cleanliness. The floors should be impervious, the walls smooth and the room kept free of dust by daily washing. The walls and rooms should be periodically disinfected and exhaust ventilation should be provided. The workroom should be well ventilated before and after use. Contact with possibly infected material should be reduced to the lowest possible point. The use of impermeable aprons and rubber boots is advisable where workers tan, scour, boil or bleach animal products. In handling, sorting or manufacturing dry hides the use of a respirator is recommended. Overalls, gloves, and neck protectors should be provided for workers carrying material on the shoulder but, if possible, conveying apparatus should be substituted for hand labor.

---

[1] Andrews, J. B. "Anthrax as an Occupational Disease," *Bulletin Number 267*, p. 34. United States Bureau of Labor Statistics.

XII

PHYSICAL EXAMINATION

Its object. Relation to health of workers. Physical impairments. Classification of disabilities. Advantages and disadvantages. Types of examination. Basis and methods. Examination form. Defects and rejections. Time, length, and place of examination. Special phases: hernia.

THE physical examination of workers is the basis of industrial health improvement and of plant medical work in general. The function of the family physician is to cure; he has seldom opportunity to do anything else, just as the function of the plant physician is prevention and he has every opportunity of putting such a policy into effect. Moreover, the family physician has not the facilities, even if he had the will, to know the occupational hazards as can the plant physician.

Physical examination is generally considered by progressive concerns as primarily a measure of health conservation though it may be used negatively or positively to attain that end. Negatively applied, it excludes the sick or those likely to cause sickness in others; as a positive measure it seeks to build up the health of the working force and to prolong useful lives. The physical examination is indispensable in either case and, to be of the fullest measure of usefulness, the doctor must have an intimate acquaintance with the plant and each occupation in it.

Workmen's compensation acts have made the physical examination of workers imperative not merely because the employer is thus protected against imposition but also because, to be successful in accident prevention, he must place each individual where there will be no risk to himself or others, and, besides, the question of insurance is determined by the physical rating of employees.

The misplaced worker is often dissatisfied and from this dissatisfaction may arise a whole train of disastrous consequences. An efficient employment manager may place workers to the best of his ability but, without medical aid, he is apt to make radical mistakes. A worker can only be well and happily placed when due consideration is given to his physical and mental make-up as well as to his previous record and present condition.

THE OBJECT OF PHYSICAL EXAMINATION

Whether in the employment office, or subsequently when the worker has taken his place in the plant, the object of the physical examination is to establish the presence or absence of organic disease, to prevent communicable or occupational diseases, to detect the presence of physical defects so as to enable the worker to get cured, to place him in that occupation which suits him best, or to adapt him to his job. In a lesser, though not inconsiderable degree, the doctor shall have to seek to adapt the job to the worker, but before doing so he must convince himself as well as the management that such a course is justified by conditions. Changes of this kind, at the instance of the plant physician, have brought benefit to the worker and employer alike. The basis, then, of the physical examination is prevention, not only in an individual but in a general sense. The condition of the workers, as shown by the results of medical examination, is the only sure foundation upon which to build a scheme of health education which is so necessary a feature in prevention.

THE HEALTH OF INDUSTRIAL WORKERS

Although much disease is found in industry it is not by any means all due to industrial conditions. It might be easy for a medical department to cope with the industrial causes of sickness alone, but this restricted view-point

TABLE 37

ANALYSIS OF IMPAIRMENTS IN EXAMINATION OF INDUSTRIAL AND COMMERCIAL EMPLOYEES BY THE LIFE EXTENSION INSTITUTE

Impairment	Percentage
MINOR TO MODERATE IMPAIRMENT:	
Personal hygiene errors	86
Urine, slight changes	75
Dietetic errors	69
Nose, throat, bronchial, slight changes	66
Arteries, slight changes	42
Teeth and gums, slight defects	42
Constipation	33
Circulation, slight functional disturbance	30
Digestive tract, signs and symptoms	29
Skin affections	28
Ear defects	27
Anemia	15
Nervous affections, functional	3
Goitre	3
Unclassified	27
MODERATE TO SERIOUS:	
Urinary changes with important impairments	33
Arteries, moderate thickening	25
Blood pressure, moderate fluctuations	23
Nose, throat, and bronchial, marked changes	17

would not bring about much success. The employee, who is only at work one-third of the day, is subject to many other conditions responsible for sickness the remainder of the time, such as bad housing, food, and social conditions. It is to contend with these factors as well as the others within the plant that the physical examination proves to be an indispensable necessity.

The general physical conditions in the community, from *which industry draws its workers, have been proved to be* even worse than is generally supposed. In the great total [illegible] 3,740,000 in all [illegible]

TABLE 37 (*Continued*)

ANALYSIS OF IMPAIRMENTS IN EXAMINATION OF INDUSTRIAL AND COMMERCIAL EMPLOYEES BY THE LIFE EXTENSION INSTITUTE

Impairment	Percentage
Heart, moderate defects	15
Teeth and gums, marked infections	14
Heart, blood vessels, and kidney changes	12
Lungs, doubtful signs	9
Blood pressure, above 175	3
Blood pressure, below 100	2
Heart, advanced defects	1
Tuberculosis, positive signs	.3
Goitre, with symptoms	.07
Nervous affections, marked organic	.07
Gonorrhea	.35
Syphilis	.21
STRUCTURAL DEFECTS:	
Faulty vision	53
Posture, faulty	44
Flat foot and other defects	21
Weak inguinal rings	6
Underweight, extreme	6
Overweight, extreme	5
Rupture, with truss	3
Rupture, without truss	1

thousand examined were found to be defective. Many of these came from industrial concerns and returned to them when the war was over. In industry, therefore, physical conditions are much the same as in the army. Workers are found to be suffering from a variety of ailments which prevent them from delivering a full day's work. The Life Extension Institute, which specializes in industrial medical examinations, found conditions to be as shown in Table 37, *on the opposite page and above.*

The Life Extension Institute classified the disabilities of 10,000 workers into six groups and found, in each class, the percentages given in Table 38, on the following page.

TABLE 38

CLASSIFICATION OF DISABILITIES OF 10,000 WORKERS INTO SIX GROUPS

Class	Impairment	Percentage
1.	No physical defect or impairment report; no modification of living habits required	0
2.	Slight physical impairment or defect requiring some form of hygienic guidance	10
3.	Moderate physical impairment or defect requiring some form of hygienic guidance or minor medical, dental or surgical treatment	41
4.	Moderate physical impairment or defect—Medical supervision or treatment advised in addition to hygienic guidance	35
5.	Advanced physical impairment or defect requiring systematic medical supervision or treatment	9
6.	Serious physical impairment or defect urgently demanding immediate attention	5

Individual plant records show much the same results as those in Table 38, modified, however, by local conditions. The Crocker McElwain Company of Holyoke, Massachusetts, examined 547 applicants for employment up to July 1, 1923, and discovered the defects given in Table 39.

In the last 10 years physical examination has been adopted by one large plant after another so that not many remain who do not apply it at entrance and sometimes periodically thereafter. Within the same period, also, the International Ladies Garment Workers' Union has made physical examination compulsory for membership and has so far examined 50,000 workers. The United States Postal service has recently inaugurated physical examination for its employees, and within the last year the Master Bakers of 150 American cities have decided to adopt physical examination for all employees under their control. Between February, 1914, and July 31, 1921, the Metropolitan Life Insurance Company has authorized the Life Extension Institute to make 95,000 physical examinations at a cost of

TABLE 39

DEFECTS DISCOVERED IN EXAMINATION OF 547 APPLICANTS

Defects	Cases
Hernia, various degrees	55
Tuberculosis suspected	13
Diabetes	29
Impacted wax	27

$225,000. In the first two years 6,000 were examined and their history was observed up to November, 1920. There was a saving in the mortality expected of 28%. The National Health Council, this year, finds on enquiry that the number of persons applying for health examinations is growing and that, in the last year, nearly a million such examinations were made.

Notwithstanding these obvious advantages of physical examination for all workers the practice is generally confined to large plants. In the smaller plants physical examination hardly exists and it can only be made a practical possibility by cooperative medical service, which is as yet a rare type of enterprise. The importance of this type of development lies in the fact that small plants constitute a vast majority of the total. An investigation for the year ending May, 1924, made by the State Industrial Commission of Wisconsin shows that out of 1,046 plants with an average of about 125 employees each, only 90, or about 12%, had physical examinations for new male employees.[1] A subsequent study by the National Industrial Conference Board shows 57% in 446 establishments.

THE ADVANTAGES OF PHYSICAL EXAMINATION

Numerous, though small, benefits have been found in physical examination by the employer as well as by the worker. It is primarily intended as a means of increasing efficiency and production and it has been found to accomplish these ends. It keeps undesirables and poor risks out of the plant, prevents or lessens epidemics, enables the early discovery of disease and thereby increases the chance of recovery. By its means absentism is considerably reduced, as in such plants as that of the National Cash Register Company. The discovery of the exact physical condition of the worker at the time of entrance and subsequently prevents accidents and enables the employer to resist unjust claims for injuries.

---

[1] Wisconsin Labor Statistics, Industrial Commission of Wisconsin, Vol. II, No. 11, November, 1924.

The worker benefits primarily by having his general health supervised without cost. He is made aware of the dangers of disease, his periods of sickness are reduced, and he is enabled to become a steady wage-earner. He saves money on doctors' bills and, at the same time, increases the amount in his pay envelope. By the exclusion of applicants with contagious diseases the regular force is protected and its exposure is reduced. An intelligent knowledge of a man's physical condition enables the doctor to place him where he can produce most, with the least physical strain and, with resulting content. Through proper medical inspection the man with a weak heart is placed at a job with a minimum risk from accident to himself or others. At a moderate computation a worker is saved $20 a year in doctors' bills while improved health increases his earning capacity, reduces the number of days away from work, and adds, at least, $10 or $15 a year to his wages in this way alone.

The physical examination of workers has certain disadvantages. It not only costs the employer money without calculable return but it slows down the work of the employment office quite considerably. Foremen, who are accustomed to hire help without formality, are often hampered by the delay consequent on a visit to the medical department when they are in urgent need of men. The exclusion of workers when labor is short is another source of grievance, as is the fact that physical examination decreases the number of applicants, who can get work elsewhere without having to undergo the ordeal.

The applicant objects to physical examination because it may exclude him from work on account of physical defects which, if discovered, bring no treatment or even advice. He feels that, even if hired, he does not want to be lectured as to how he should live. Should he leave, having disabilities, his chances of reemployment are small. It is further claimed that physical examination is used as a means of discriminating against trade unionists by discovering fancied ills. As Walter Dill Scott says, "The practice of making physical examinations has infinite possibilities of misuse in the hands of unscrupulous employers. Labor unions have almost universally gone on record as opposing it. They claim that it had been used as a form of legitimatized blacklist, whereby workers distasteful to the management can be prevented from obtaining employment on the basis of some slight or invented ailment." [1] Whether this is a valid claim or not the situation undoubtedly exists and objection to physical examination was one of the ostensible grievances set forth in the great steel strike a few years ago.

In those remaining instances where physical examination has not yet been introduced, perhaps a few words are necessary as to the method of introduction. There is no denying that most persons, left to themselves, will avoid the nuisance of going through a physical examination, particularly as they feel that no need for it exists. Foreigners are reputed to object to medical examination even more than natives, but that is generally because they do not understand the matter any more than English speakers. Although the suspicions are groundless they must be dispelled and the first step therefore is to explain the fact that workers, although they may not suspect it, are often subject to certain diseases which may easily be cured if found in the early stages. Needless to say, executive approval and help are necessary, and if the "big boss" steps down into the medical department and takes the first physical examination himself little objection will be made by the workers. This is the best, but not the usual, practice. Workers suspect the plan instinctively when they see the officials leaving it severely alone.

---

[1] Scott, Walter Dill. *Science and Common-Sense in Working with Men.*

Interest in the subject can be stimulated by an educational campaign usually through the medium of the plant publication. This should take the form of explaining what has been done in other plants and the advantages derived therefrom. Short talks to the foremen and superintendents explaining the matter will tend to diffuse correct ideas as to what is about to be done and, later, groups of employees may be spoken to from time to time.

Certain details of operation are often perplexing. Shall the examination be compulsory or voluntary, occasional or periodic, at entrance or subsequently? It is desirable to decide these matters before making a start. Compulsion is a last resort except in the case of applicants. Experience shows that applicants are quite willing to undergo a physical examination when there is the possibility of employment. The situation is different with the regular employee. He looks on the subject as a tyranny and an infringement of his rights as a free man unless voluntariness is one of the conditions. When physical examination is voluntary from the start, a favorable sentiment is created and compulsion is seldom necessary. After most of the employees have voluntarily been examined, the argument for compulsion with the remainder is strong. In the Greenfield Tap and Die Company voluntary examination was accepted by half of the employees. The Eaton Crane & Pike Company made it voluntary and subsequently compulsory, feeling that the results obtained under the voluntary system justified its application to the remainder of the force.

Another question to be decided is as to whether the examination shall be periodic or not. Some employers are content to have the entrance examination and it alone.

Others believe there should be a periodic examination of all employees, while a third group favor reexamination, depending on ascertained defects or on signs of sickness, and return to work after sickness. The latter appears to be the most sensible plan. Its aim is to make a physical examination whenever and as often as is necessary. A periodic examination, every six months or a year, for those who are healthy, is not only a nuisance for workers but it takes up much of their time, disrupts the working routine, and gives negative results in the large percentage of cases. Any adequate plan of health education makes workers sensitive to their physical condition and they seek medical aid readily enough. The cases where a disease steals on the worker unaware are few. In any case the physical examination at entrance is sufficient to show what employees need periodic examination. Periodic physical examination consumes the time of the doctor and leaves him little time for other and, perhaps, more important work. As a modification, some plants insist on physical examination once a year for persons over 50 years, and one every two years for those younger. Periodic physical examination has its most strenuous advocates among those who suffer no inconvenience or cost from its imposition. In actual practice various occasions arise in the course of a year where physical examination may be repeated objectively, such as, for instance, when a worker desires to join a mutual aid association or when he complains of sickness. Physical examinations made at such times are highly useful and generally meet the situation adequately.

The usual practice, in industrial medicine, is to limit physical examination to the working force. If, however, it is good for the man at the machine it is doubly desirable for the higher grade employees, and, in some cases, every one in the plant without exception is examined. Dr. W. A. Sawyer, of the Eastman Kodak Company, says that, "With respect to periodical physical examinations for all executives, nothing in industrial medicine can pay such handsome dividends and so completely sell the worth of the work as a whole."

When the employer requires his staff to conserve their health in this manner they should be allowed the alternative of examination by the plant physician or by an outside examiner, although the latter is less likely to have experience in making such examinations. It may be truly said that the higher the grade of employee the greater the need of health conservation, since it is less easy to replace a high official than a laborer.

THE TYPES OF PHYSICAL EXAMINATION

There is no one type of physical examination for all situations. The common-sense course is to fit the examination to the need. The first examination is not medical at all nor is it carried out by the doctor. In every properly managed employment office of size an interviewer, who is provided with full information as to company policy in hiring workers, sees the applicants on entering the employment office and weeds out the undesirable or those who do not comply with the required standards and conditions of employment. His sole object is to eliminate the obviously unfit and thus save the time that might otherwise be spent by the employment manager. Then follows, for those who remain, a physical inspection, whereby the interviewer is able to determine at a glance whether the applicant is a possibility for employment.

After the applicant has been selected, tentatively, for employment comes the physical examination proper, the assumption being that every one passed by the employment office is suitable for the job selected in every respect other than the medical. It is now the doctor's responsibility to determine on selection or rejection, his attitude being guided not only by the medical findings but by the plant needs as well. Obviously the condition of the labor market must be considered. When the labor market is full few will be hired and it is necessary to raise the physical standard as high as possible. If labor is short the requirements need not be so rigid. Applicants may be accepted tentatively and a more exhaustive examination made subsequently, involving blood count, sputum, urinalysis, and the like, as may be advisable. Usually this special examination is reserved, not for applicants, but for the older employees, since every effort must be made to keep the force healthy when it is hard to replace men.

Physicians, like other human beings, have their idiosyncrasies and fads, which become evident in their manner of making an examination. Some doctors are incipient specialists in heart, lungs, or throat to the exclusion of other factors, and the result is an unbalanced examination. In order to guard against this his work should be based on general knowledge of physical ills or, better still, on his experience of defects found in industry. The doctor should not be tempted to look for the unusual but for the usual maladies, guided by his knowledge of the plant in general and of each occupation. No doctor can make a satisfactory finding on pure theory. He must have first-hand acquaintance with the occupation to which he intends to assign a worker. Such knowledge may be obtained from two sources: inspection of the jobs themselves, and the job specifications. Not knowing the conditions under which each job is done he may accept a rheumatic for a wet job, or a flat-footed man for standing work. The job specification, also used in hiring, is an inventory of all the material facts relating to each occupation. By having a specification for any specific occupation before him the doctor is able to proceed intelligently.

METHODS OF MAKING THE PHYSICAL EXAMINATION

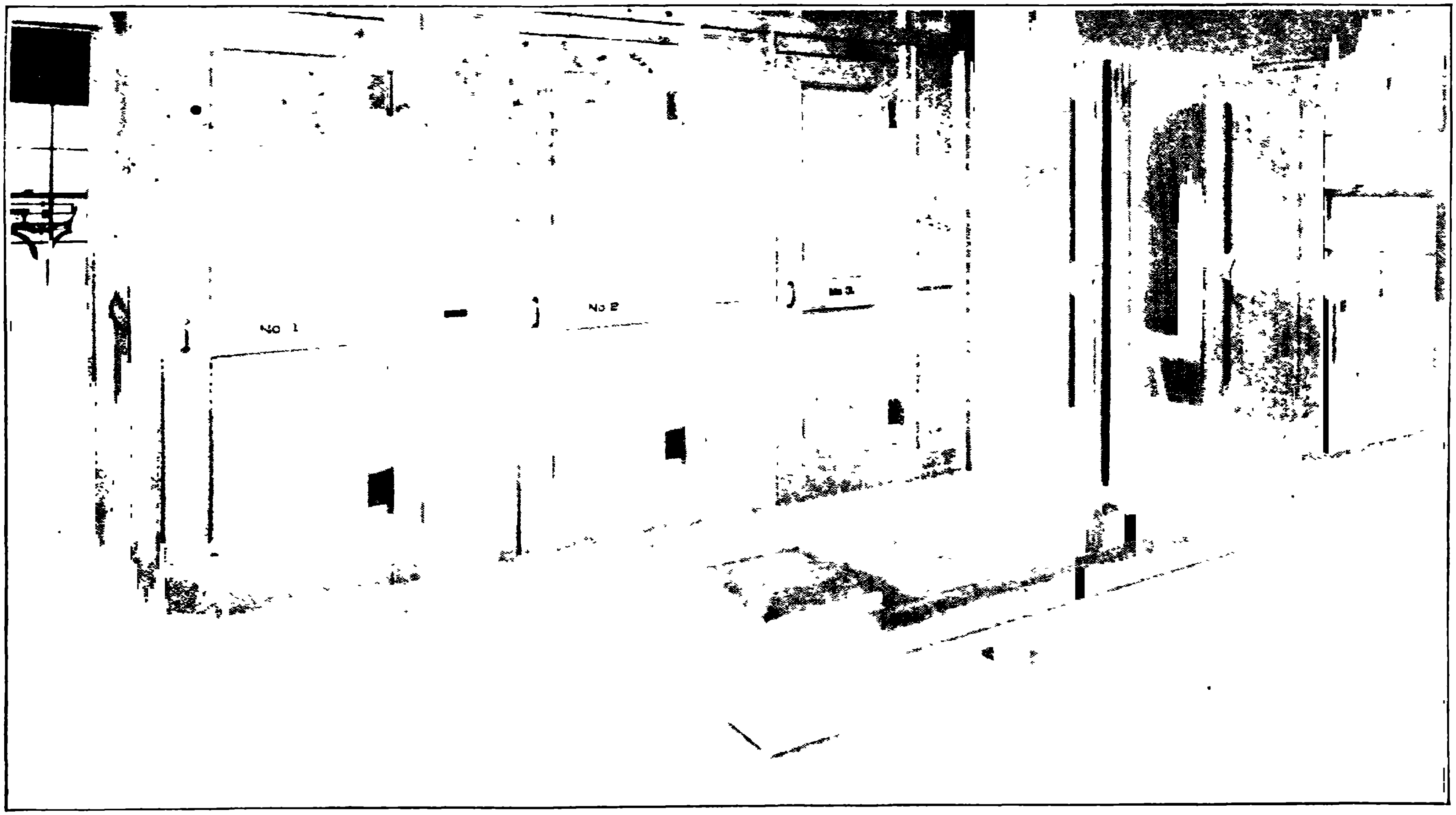
The reception of the applicant by the doctor often determines the nature of their future relations. "Greet the applicant cheerfully," says Dr. Colcord, "and according to his personality. . . . Many applicants are nervous, some are frightened, and some ugly at having to submit to examination. Some are inclined to be overfamiliar with the examiner. The greeting must be such as to quiet the nervous, allay the fears of the frightened, win over the grouchy one, and command the respect of the overbold and familiar. Above all, this first greeting must win his confidence and make him feel that the physician is his friend." This is all very important as a working basis between the doctor and the examinee. In general the attitude should be that with patients in private practice, neither more nor less.

The applicant, coming from the employment office, should bring with him a copy of his answers to the questions in the interview so that questions will not have to be repeated. This saves time in the medical department and avoids the appearance of the grand inquisition.

THE NEED FOR SYSTEM

Whatever plan of examination is adopted it should be followed methodically in each case, to increase its efficiency and to reduce the time. If the physical examination record is arranged in some logical order the examination can be made with expedition and no important point is likely to be overlooked. There should be a division of work between the doctor and nurse or clerk with the object of saving the doctor's time. The nurse, whose greeting should be as cordial as that of the doctor, should proceed to get, from the form brought in by the applicant, whatever information is needed for placing on the physical examination record. To this should be added facts as to history, details as to height and weight, eye tests, and such other work as can be done competently by the nurse under instruction from the doctor.

The doctor is now ready to see, and should see, the candidate as a whole on approach, so that his walk, car-



Courtesy General Electric Company, Schenectady, New York

Figure 5: Medical examination waiting-room and dressing booths

riage, and appearance may be observed. In some plants the custom is to have the applicant come in fully dressed; in others he comes into the examining room naked and alone. The latter is accomplished by having a series of dressing booths along one side of the examination room where applicants can dress and undress, and from which they come on call. The latter plan saves time and is more efficient from the point of view of the doctor, but it may be objectionable to the worker and can be modified to suit the occasion.

The examiner, here, makes a rapid physical inspection, particularly to see if there is any apparent cause for rejection, so that the examination may be discontinued at as early a moment as possible in case there is. In approaching the examiner the examinee may disclose by his carriage the fact of spinal curvature or flat feet and particularly any deformities. Reference to the card brought in by the examinee gives his name, residence, age, height and weight, and the job to which he is assigned. A closer scrutiny shows development and nutrition, signs of dissipation or sickness, all this in little more than a glance. It is now necessary to supplement the employment office record by noting the medical and family history such as previous injuries, operations, vaccinations and sicknesses, and information regarding the causes of sickness and death among relatives. This had better be ascertained by the examiner since it gives him an opportunity to observe the individual physically and mentally. Such an examination is among others "one of the best guides to nervous instability."

The systematic physical examination now begins; the examiner starts at the crown of the head and observes in succession the hair, scalp, face, eyes, ears, nose, and mouth. Ordinarily the eyesight may be tested by the nurse, leaving to the doctor examination of the lids unless the work is specially exacting. Sometimes applicants pocket their glasses for the time being hoping that weakness of sight will not be discovered. Hearing may be detected in the course of conversation or by means of a ticking watch at specified distances. Acute hearing is a factor where orders have to be received or in busy yards. The teeth are next seen and their condition noted. Bad teeth may be a cause for rejection or reference to a dentist if one is not employed in the plant.

Up to this point the examinee may be fully dressed but, on the examination of the chest, heart, and lungs, all clothing from the waist up must be removed. After the abdomen, back, and spine have been inspected the trousers and underclothing are dropped down for examination of the hernial region, genitals, and legs. On drawing up the trousers and taking off shoes and socks the feet, ankles, and arches are seen, which completes the examination except in doubtful cases.

The examinee now returns to the dressing booth and the examiner, after completing his notes, is ready for the next person. On the basis of these findings the examiner decides on selection or rejection. It is good practice to take on, not only healthy men, but those who have slight ailments which can easily be cured, in which case provision must be made to follow up the matter either by arranging at the time for a future visit or by having the clerk notify the foreman to have the worker return on a certain date. In some places it is the custom to avoid discussion with the rejected applicant as to his condition; in others the doctor notes defects and explains how they may be cured or avoided. If there is to be a rejection the reason is stated in a reasonable way and some advice is tendered. When the ailment is only temporary the applicant may be asked to call again when sufficient time has elapsed to permit his ailment to disappear.

In some places, at the end of the examination a blank is handed out asking questions as to hygiene, habits, and general health and if it is returned a written report of the examination is given on request.

THE PHYSICAL EXAMINATION FORM

The Conference Board of Physicians in Industry has adopted a standard physical examination method to be used in making examinations. Its systematic use prevents important matters from being overlooked and increases the facility with which examinations can be made.

STANDARD PHYSICAL EXAMINATION OUTLINE

Adopted by the Conference Board of Physicians in Industry,
November 18, 1922.

SPECIAL SENSES

(*a*) Eyes:

Visual Acuity: Right eye......... Left eye.........

Visual acuity of 20/40 or less in both eyes indicates specified employment—Class III, and further investigation.

Visual acuity of less than 20/30 in one eye and less than 20/200 in the other with suitable correction indicates specified employment—Class III.

A greater disparity in vision of the two eyes indicates need for further investigation.

Reading Test: Right eye......... Left eye.........
.....................Size of type.....................
.... Distance ....

Field of Vision: Right eye......... Left eye.........
.................Normal or Limited.................

Loss of more than one-third of field of vision of both eyes, or loss of two-thirds of field of either eye indicates specified employment—Class III.

Color Sense: Ability to match colors and call them correctly.

Pupils: Reaction.

Puffiness of Lids.

(*b*) Ears:

Drums: Right ear............ Left ear............
.... Appearance ....
Hearing power..................By watch...........

Use Ingersoll one dollar watch at 36 inches as normal. Any variation from normal to be indicated by a fraction whose numerator is 36, the denominator being distance at which watch can be heard. Deafness to be indicated by the word "contact." Hearing power of less than one-half normal indicates specified employment—Class III.

(*c*) Nose:

Septum.
Turbinates.
Obstruction.

(*d*) Mouth and Throat:

Condition of teeth.[1]
Condition of gums.
Condition of tonsils.[2]
Thyroid enlargement.

CHEST EXAMINATION

(*a*) Heart:

(1) Myocardial test: Effort syndrome. Pulse reading before and after exercise.

(2) Blood pressure taken on all cases over forty years of age; others as indicated.

(3) Valvular disease, compensated or uncompensated.

(4) Arhythmia.

(5) Tachycardia.

(*b*) Lungs:

(1) Inspection—lagging, apical retractions.

(2) Auscultation—eight points to examine closely as follows:

Front: Apex of lung—right and left. Infraclavicular space—right and left.

Back: Suprascapular space—right and left. Base of lung —right and left.

ABDOMINAL INSPECTION

Abdomen. Inspection. Abdominal tumors.

Hernia:

Inguinal: complete, incomplete, oblique, direct.

Size of external ring——.

---

[1] All deformities and contagious conditions should be noted in the proper place. Applicants should be rejected on physical grounds only when their employment would make them a menace to themselves, to others, or to property.

[2] Same as for Footnote 1.

Impulse, present or absent-
Femoral hernia. Ventral hernia. Umbilical hernia.
Post-operative hernia. Abdominal wall hernia.

Spine: Curvature, mobility.

Anus: Hemorrhoids, fissures, fistulae, protrusions.

Genitals: Examined for varicocele and hydrocele.

CONDITION OF EXTREMITIES

(*a*) *Lower:* Varicose veins; joint mobility; loss of member; deep reflexes; foot strain.

(*b*) *Upper:* Joint motility; loss of member; loss of digits; tremors.

General: Gait, Romberg, Skin.

Height, weight and age to be recorded.

Suggested classification for conditions of teeth: (1) Good —No repair needed; (2) Fair—Minor defects; treatment advisable; (3) Bad—Serious defects needing immediately corrective treatment.

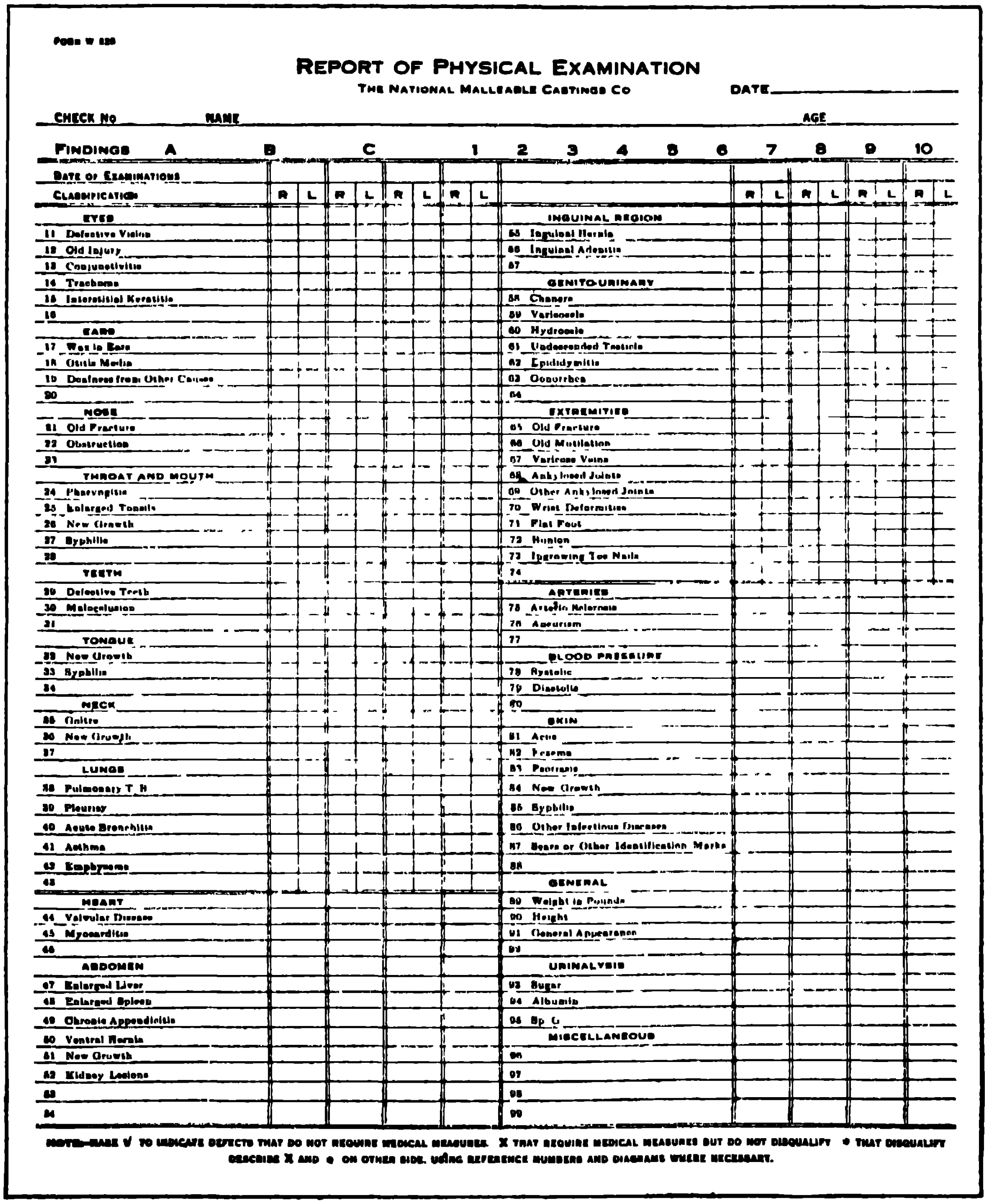
Diseased tonsils in adult should be removed. Such cases should be followed and removal advised. In absence of other disability diseased tonsils should put the person examined in Class II.

Following questions will give a good background for obtaining important family history information: (1) When did you last consult a physician? (2) Have you ever been in hospital or sanitarium? (3) Have you ever had heart trouble, lung trouble or tuberculosis? (4) Have you ever had tonsilitis? (5) Have you had fits or fainting spells? (6) Are you well and strong? (7) Have any relatives had tuberculosis? (8) Have you ever had accidents, operations or injuries? (9) Have you weak lungs or heart trouble?

CLASSIFICATION OF PHYSICAL FINDINGS

Classification of Physical Findings: *Class I.* Physically fit for any work. *Class II.* Physically underdeveloped, or with some slight anatomical defect; otherwise fit for any work. *Class III.* Fit only for certain employment when specifically approved and supervised by the medical department. *Class IV.* Unfit for any employment.

The arrangement of the physical examination form should facilitate the record of the findings. The "Report



FORM W 128

REPORT OF PHYSICAL EXAMINATION

THE NATIONAL MALLEABLE CASTINGS CO DATE

CHECK NO NAME AGE

FINDINGS A B C 1 2 3 4 5 6 7 8 9 10

DATE OF EXAMINATIONS

CLASSIFICATION R L R L R L R L R L R L R L R L

EYES
11 Defective Vision
12 Old Injury
13 Conjunctivitis
14 Trachoma
15 Interstitial Keratitis
16

EARS
17 Wax in Ears
18 Otitis Media
19 Deafness from Other Causes
20

NOSE
21 Old Fracture
22 Obstruction
23

THROAT AND MOUTH
24 Pharyngitis
25 Enlarged Tonsils
26 New Growth
27 Syphilis
28

TEETH
29 Defective Teeth
30 Malocclusion
31

TONGUE
32 New Growth
33 Syphilis
34

NECK
35 Goitre
36 New Growth
37

LUNGS
38 Pulmonary T. B.
39 Pleurisy
40 Acute Bronchitis
41 Asthma
42 Emphysema
43

HEART
44 Valvular Disease
45 Myocarditis
46

ABDOMEN
47 Enlarged Liver
48 Enlarged Spleen
49 Chronic Appendicitis
50 Ventral Hernia
51 New Growth
52 Kidney Lesions
53
54

INGUINAL REGION
55 Inguinal Hernia
56 Inguinal Adenitis
57

GENITO-URINARY
58 Chancre
59 Varicocele
60 Hydrocele
61 Undescended Testicle
62 Epididymitis
63 Gonorrhea
64

EXTREMITIES
65 Old Fracture
66 Old Mutilation
67 Varicose Veins
68 Ankylosed Joints
69 Other Ankylosed Joints
70 Wrist Deformities
71 Flat Foot
72 Bunion
73 Ingrowing Toe Nails
74

ARTERIES
75 Arterio Sclerosis
76 Aneurism
77

BLOOD PRESSURE
78 Systolic
79 Diastolic
80

SKIN
81 Acne
82 Eczema
83 Psoriasis
84 New Growth
85 Syphilis
86 Other Infectious Diseases
87 Scars or Other Identification Marks
88

GENERAL
89 Weight in Pounds
90 Height
91 General Appearance
92

URINALYSIS
93 Sugar
94 Albumin
95 Sp. G.

MISCELLANEOUS
96
97
98
99

NOTE—MARK ✓ TO INDICATE DEFECTS THAT DO NOT REQUIRE MEDICAL MEASURES. X THAT REQUIRE MEDICAL MEASURES BUT DO NOT DISQUALIFY ● THAT DISQUALIFY DESCRIBE X AND ● ON OTHER SIDE, USING REFERENCE NUMBERS AND DIAGRAMS WHERE NECESSARY.

Figure 6: Form used for physical examination report by the National Malleable Castings Company

of Physical Examination" of the National Malleable Castings Company, on the following page, modified to suit local conditions, may be used. This form has been adopted in 64 plants.[1] The code at the top indicates the kind of work suitable to the findings of the examination. Its advantages are as follows:

---

[1] Selby, C. D. *Scope of the Physical Examination in Industry.* Read before Health Section, National Safety Council, Eighth National Congress, October 3, 1919.

1. It provides for specific mention of conditions most usually found, and for the recording of unusual conditions.
2. It records findings practically in the order of inspection and indicates at a glance the side of the body involved.
3. It permits recording with a minimum of clerical effort.
4. It permits tabulations and compilation of reports with a minimum of medical knowledge and clerical effort.
5. It permits diagrammatic representation of abnormalities and amplified description of special features (on back of form).
6. It permits the recording of three subsequent inspections in direct comparison with the original.
7. It has a wide range of adaptability in the recording of information secured by means of any of the various grades of examination, except the special examination.

Those examined may now be classified into groups indicating their physical status in relation to the work. The Conference Board of Physicians uses this classification:

(*a*) Physically fit for any work;

(*b*) Physically underdeveloped, or with some slight anatomical defect; otherwise fit for any work;

(*c*) Fit only for certain employment when specifically approved and supervised by the medical department;

(*d*) Unfit for any employment.

Another classification is, (*a*) Acceptable—fit for any occupation, (*b*) Limited—suitable only for certain jobs; and (*c*) Rejectable—unsuited for work under present disability. Persons in class (*c*) may enter class (*b*) on removal of the disability. Weak-sighted persons on getting glasses, for instance, may go from class (*c*) to (*b*). In some plants the classification is more elaborate and divides the physical rating of the applicants into eight classes. The physical examination form should have provision for recording the classification and the medical department must have available a list of occupations with their physical classification.

DEFECTS AND REJECTIONS

The number of defects found vary largely and the rejections resulting therefrom vary with the condition of the labor market and with the physical standards set. When labor is scarce it is found possible to adapt nearly every applicant to some kind of work. However, the easiest way of raising the general health of a plant is by a rigid exclusion of those found to be below par. The industrial physician is naturally exposed to this temptation.

The basis for rejection is fitness for the particular job vacant at the time of hiring, and this includes those who may be a danger to themselves, to others, or to the plant while occupying that position. In some cases a man excluded from one job may be quite suitable for another since it is not likely to aggravate his condition or that of others. Special Regulations Number 65, Standards of Physical Examination for entrance into the United States Army, is useful for showing methods and requirements of the army physical examination and for indicating usual causes of rejection.

The percentage of defects discovered by the examiner on

TABLE 40

APPLICANTS EXAMINED AND REJECTED ON PHYSICAL EXAMINATION—TEN INDUSTRIES

Particulars	Number	Percentage
Total number of applicants examined in one year	118,900	
Total number employed having disabilities that did not interfere with selected work	41,158	34.7
Total number rejected for work because of disabilities	11,433	9.7
Total number having no disabilities of any moment	66,309	55.6

physical examination is usually large and bears no relation to the number of rejections which may be necessary. Not infrequently persons have two or even three defects remediable or otherwise. Dr. Harry E. Mock[1] found the following situation among the applicants in 10 large industries examined in one year.

The percentage of rejections is unusually high, as will be seen from Table 41. It may be interesting to note, however, that, in the United States Naval service for 1916, over 62% were rejected.

TABLE 41

APPLICANTS REJECTED ON PHYSICAL EXAMINATION—VARIOUS INDUSTRIES

Year	Industry	Number of Applicants	Rejections	
			Number	Percentage
1918	Grinding wheels..... ..	2,914	94	3.5
1915	Mail order.... .	13,764	468	3.4
1916	Department store. ...	725	36	5.0
1918	Army supplies . ..	1,854	85	4.6

In the industrial physicians' exhibit at the Cincinnati Health Exposition in 1921 it was shown that, "11,800 physical examinations were made in all in 1920 (in 10 industries); that the average percentage of rejections was 5.7%; and that rejections varied from 1.2% to 8%."

In a study of sickness and accident experience covering a five-year period, made by Dr. C. O. Sappington, for the Edison Electric Illuminating Company of Boston, on an average of 2,233 employees, the conditions given in Table 42, on the following page, were found.

Table 43, on page 229, gives a list of diseases, for males and females, causing lost time in the Sears, Roebuck Company, Chicago.

Tables 42 and 43 are interesting for several reasons. They show the preponderating incidence of the common cold, and of the respiratory diseases in general as a cause

---

[1] Mock, H. E. *Industrial Medicine and Surgery*, 1919.

TABLE 42

SICKNESS AND ACCIDENT EXPERIENCE—EDISON ELECTRIC ILLUMINATING COMPANY, BOSTON, 1918-1922 [1]

(Females to males, 1 to 4.5)

Diseases	Cases		Days Lost	
	Number	Percentage	Number	Percentage
Common colds...	5,328	34.3	16,983	20.4
Diseases of stomach	1,246	8.0	2,647	3.1
Pharynx and tonsils	1,007	6.5	4,698	5.6
Accidents in plant	774	4.9		
Functional nervous diseases.......	731	4.5	6,882	8.2
Dysmenorrhea...	683	4.2	1,486	1.8
Rheumatism, arthritis, and gout.......	651	4.1	4,781	5.7
Influenza..........	567	3.6		
Diseases of liver..	462	2.9		
Home accidents...	448	2.8		
Diarrhea-enteritis....	354	2.3		
Mouth and annexa..	325	2.1		
Bronchitis...........	287	1.9		
Food poisoning.....	283	1.8		
All other conditions	2,356	15.1		
Total accident cases	1,222	7.9		
Total diseases	14,280	92.1	83,280	
Grand total	15,502			

of lost time. Comparison between these tables is impossible owing to the difference in classification, apart altogether from the difference in industry.

CAUSES OF REJECTION

Causes for rejection may be due to heart, kidney, lungs, hernias, syphilis and other contagious diseases and, in some cases, variocosities and flat feet. Morris & Company, of Chicago, reject men for contagious diseases such as syphilis and tuberculosis, skin rashes and eye diseases, also poor safety risks such as hernia, bad sight, paralysis, fits, and the physically undesirable such as the weak-lunged and rheumatic persons, and this conforms to general practice.

---

[1] Sappington, C. O. "A Five Years' Sickness and Accident Experience in the Edison Electric Illuminating Company, Boston," *Journal of Industrial Hygiene*, July, 1924.

Dr. W. I. Clark,[1] of the Norton Companies, says that:

> Applicants having the following defects may be admitted to most factories without undue risk, provided they are selectively placed and watched:
>
> (*a*) Hernia of long duration which is complete or well held by a truss, provided the applicant has done work similar to that for which he is hired for the four weeks preceding;
>
> (*b*) Varicose veins, provided ulcer and edema of ankles are absent;
>
> (*c*) Varicocele supported by suspensory;
>
> (*d*) Flat foot if without symptoms; that is, pain in foot when applicant walks on toes, pain in back on bending over;
>
> (*e*) Deafness, except in special departments;
>
> (*f*) Vision, depending on hazard and department;
>
> (*g*) Arteriosclerosis;
>
> (*h*) Endocarditis, unaccompanied by marked myocarditis;
>
> (*i*) Arrested tuberculosis—in special departments.

The following five types are considered specially hazardous:

1. Arthritis of spine or sacro-iliac region;
2. Arthritis of joints of long bones;
3. Old injury to bones entering into a joint;
4. Infected tonsils and those suggesting tendency to infection;
5. Potential hernia in southern Europeans of stocky build.

The object of physical examination is not to make the plant a haven of physically perfect specimens but rather to raise the standard of health by improving and maintaining the physical condition of the worker. It is by the latter policy that the doctor secures satisfactory results and the employer builds up a fund of good-will. Strict exclusion is a selfish policy which deprives the doctor of his best field for improvement.

---

[1] Clark, W. Irving. "Our False Standards of Disability in Industry," *The Nation's Health*, October, 1921, p. 566.

TABLE 43

DISEASES CAUSING LOST TIME, 7,000 MALES, 5,000 FEMALES[1]

Minor Conditions	Male		Female	
	Number	Percentage	Number	Percentage
Headache	1,255	19.00	3,778	24.0
Dysmenorrhea		. .	2,935	18.9
Colds	1,313	20.40	2,251	14.0
"Grippe"	956	14 80	1,354	8.0
Tonsillitis	883	13 70	974	6.0
Nausea	203	3.10	750	4.8
Other stomach conditions	331	5.00	403	2.6
Nervousness	42	.60	355	2.3
Neuralgias, myalgias, pain in joint	123	1.90	188	1.3
Backache	111	1.80	153	1.0
Stiff neck	30	.40	99	.6
Eye conditions	56	.87	172	1.2
Ear conditions	36	50	102	.6
Fever	107	1 80	110	.7
Diarrhoea	74	1 10	130	.8
Constipation	41	60	92	.6
Fainting	13	20	132	

Serious Conditions	Male		Female	
	Number	Percentage	Number	Percentage
Appendicitis	35	50	48	300
Bronchitis	45	.60	27	.180
Heart trouble	2	03	8	050
Kidney disease	4	.06	4	020
Pleurisy	24	.40	9	.060
Pneumonia	12	.20	2	.010
Paralysis	1	.01	1	.007
Rheumatism	122	1.74	90	.600
Anemic and generally run down		.06	34	.200
Acute and contagious diseases	32	.50	32	.200
Typhoid fever	1	.01	1	.077
Tuberculosis	15	.23	19	.140
Miscellaneous	505	7 80	1,281	.400
Total.	6,420		15,244	

In support of this thesis that one should be cautious in rejecting applicants for the usual list of complaints, Dr. Clark contrasts the time lost by men in the rejectable class with that of others having back strain, rheumatism, and tonsillitis. The former lost 502 days (excluding hernia not apparent on admission) while the latter lost 1,011 days. Compared with 11,648 days lost on account of sickness during the same period of time, both groups sink into significance.

---

[1] Mock, H. E. *Industrial Medicine and Surgery*, W. B. Saunders, 1919.

THE TIME OF EXAMINATION

A divergence of opinion exists as to whether workers should be examined before going on the job or some time after. It is generally found that the first-class plants, from a medical point of view, persist in making the examination before the applicant goes to work. If the purpose of physical examination is to keep out the unfit and the infected; if it is to place a worker in the job for which he is suitable, then the only time to make the physical examination is before the worker gets on the job. Persons who balk at the physical examination are few and have reason to fear its findings. "It is now recognized that whenever possible an examination should be made before employment in the factory," said a plant physician who rarely rejects men and takes particular pains to place them properly.

The arguments on the opposite are somewhat as follows:

> We examine our men after they have gone to work. Several obvious reasons present themselves for this procedure. First, it is easier to induce men to go to work. They do not have ever in their mind that immediately following the acceptance of the job they will have to be subjected to a physical examination—a thing ever repulsive to the workers. This way they will be given a chance to see if they like their job and want to stay with it. Our experience is that the men don't mind the physical examination so much after they are hired. In fact, a refusal is a rare thing. These are usually among the ignorant whites.
>
> Second, the examination can be made more thoroughly and will be of greater benefit to the employees. Our big hiring day is Monday. The rest of the week is slow in comparison. Thus, if the doctor had to examine all of Monday's applicants on Monday, he could do nothing else but give them a very superficial examination. . . .

Third, examinations on which the doctor can spend time and give adequate counsel create loyalty to the company and give the man a view that the company doctor is a real friend, not one who does just as little as possible because he is a company doctor.

Thomas de la Rue and Company follows a middle course. All persons who accept employment are liable for medical examination, but the medical adviser makes sure that new employees are not suffering from any serious complaint.

The principal objection to medical examination before employment is that the foreman has to wait. But he also has to wait for material if he has not the foresight to order it beforehand. Foremen are known to ask habitually for more labor than they need so that the delay is not always so serious as represented. When the foreman knows that he cannot have help the moment he wants it he is usually able to accommodate himself to the change. It is generally believed that applicants object to physical examination. They sometimes do, but not so seriously as to prevent them from still seeking employment. "Out of many thousands I have found but two or three who withdrew their applications when they found they would have to be examined," is a fair statement of the situation.

THE LENGTH OF THE EXAMINATION

The length of time taken to make a physical examination varies because methods vary and because each case is different. Normal cases, and the majority are normal, take from six to eight minutes and abnormal cases take from eight to twelve minutes on the average. Some, of course, take considerably longer and the time is regulated only by one consideration—that of ascertaining the physical condition of the worker with reference to his work.

Unless the method of examining is highly organized a competent examination cannot be made in the time mentioned above. All the routine work that can be done by the nurse or attendant in charge should be done by her so that the doctor is left free to concentrate his attention on the examination. The necessity of systematizing methods of examination becomes apparent when a succession of examinations have to be made. In order to shorten the time some doctors have a clerk who marks up the examination card, but this procedure destroys privacy and does not really save much time since it is only necessary to mark the card infrequently. The average number of disabilities found rarely exceed two per person. The number of examinations that can be done in a day is, in practice, much less than at the rate of eight per hour.

THE PLACE OF EXAMINATION

The layout of the plant, the purpose of the examination, the convenience of the examiner and examinees all contribute to a decision on the location of the examination room. Usually it is a choice between having the examination room at the employment office or in the main medical building which is separate from the employment office and generally centrally located. If the plant is compact the location is immaterial, but in a large plant the location may make much difference in operating efficiency. As regards the examination of applicants the best place is to have the examination room as close to the employment office as possible. This is all the more advisable when the number of applicants is large and when the number of routine examinations of employees is small. Even if the examiner has to attend to accident cases as well, most of the work is done with applicants before injuries have to be dressed and, in emergency, the doctor is always accessible. It is often desirable to have an examination room at the employment office where the doctor can attend in the morning and one at the emergency hospital where examinations may be made of employees during the day if the plant is widely diffused, in which case the employment office may be a considerable distance from the center of the plant.

When the physical examination room is in the employment office building the waiting-room can be used in common, thus saving space. After acceptance by the employment manager the applicant is ready to see the doctor and is seen by the latter in rotation. While one man is being examined another steps into the dressing booth adjoining the examination room and undresses and, when stripped, is called for by the doctor. In the Clairton plant of the Carnegie Steel Company, the physical examinations are made in a room 10 by 26 feet, with three windows on one side. It is also well lighted by electric lights. The furniture consists of stationary wash-basin, desk, swivel chair, two still chairs, and a small desk for surgeon to write on while making examinations. A rug is on the floor, covered with a square of heavy duck, to be changed frequently. A surgical table is placed at one end of the room, on which the applicant lies during part of the examination. At the other end of the room are test charts for the eyes.

The surgeon should be provided with the usual instruments for examination: scales, for measuring and weighing; stethoscope; blood-pressure instrument; microscope and accessories; tape measure; ruler; ophthalmoscope; nose and ear specula; tongue blades; and head mirror. In case where some special examination is needed, such as x-ray, blood count, or Wassermann, there should be some arrangement whereby this can be done in a nearby hospital.

The floor of the dressing room should be covered with some material which can be cleaned daily. There should be a shower bath and toilet connected with dressing room or within easy access.[1]

SOME SPECIAL PHASES OF PHYSICAL EXAMINATION

Hernia, usually called rupture, a protrusion of the intestine through the peritoneum, is, as Dr. C. A. Lauffer says, "the greatest single frailty of industrial workers" in certain of the heavy trades. It is believed by some to be caused, by others to be accelerated, by heavy work such as lifting, pulling, or pushing. This division of opinion has led to much debate in the matter of compensation, but compensation is almost invariably granted on the theory that the rupture arises out of employment and hence its importance in physical examination, even though it may be a non-occupational disease, merely arising from an anatomical defect.

---

[1] Colcord, A. W. "The Physical Examination of Employees," *Modern Medicine,* April, 1922, p. 225.

According to the Iowa State Commissioner, "Compensable hernia results from specific accident or incident involving unusual conditions such as strain or fall, or other fortuitous experience which may be definitely described as to time and circumstances and attended by demonstrations of distress at the time the injury occurs." Lord Macnaughten, in the case of *Fenton* v. *Thorley,* said, "If a man, in lifting a weight or trying to move something not easily moved, were to strain his muscle or rick his back, or rupture himself, the mishap, in ordinary parlance, would be described as an accident."

The importance, therefore, of acceptance or rejection for employment depends on the person's condition and the nature of the occupation available. Those with incipient hernia, or even wearing trusses, should not be employed in pushing, pulling or lifting; otherwise employment is generally safe. The reason, it may be observed, that persons wearing trusses should be excluded from these kinds of work is that there is no guaranty that trusses are worn continuously.

In an examination of 76,996 applicants at the Nitro plant, West Virginia, during the war, 2,928 or 3.8% were found to have hernia, of which 93.1% were of the inguinal type. "Data on the physical examination of prospective employees reveal the fact that approximately 3% of the men offering their services to the industries have well-developed inguinal hernias; approximately 14% have incipient hernias." [1]

Hernia, according to Dr. L. A. Phelps, is of three kinds:

1. Direct injury by violence to the abdominal walls;
2. Industrial hernia, or the hernia of effort;
3. A hernia developing in the presence of weakness of the musculature but where no congenital pre-formed sac existed.

The first class, traumatic hernia, is exceedingly rare. So-called industrial hernia is believed to arise from the cumulative effect of a great number of strains spreading over a considerable period. According to McCready, hernia is never due to an accident or single increase in intra-abdominal pressure. "The empty hernial sac invites hernial contents and is the determining factor in the causation of hernia." It may, also, be due to deficient fascial and muscular support about the cord or to increased intra-abdominal pressure, as from coughing, sneezing, constipation, or obesity. Whatever the cause, the fact remains that hernia occurs frequently in heavy work and this is a sufficient reason for its receiving critical attention at the physical examination of applicants.

The Conference Board of Physicians in Industry,[2] recommends that the following should be determined:

Inguinal, complete, incomplete, oblique, direct
Size of external ring
Impulse, present or absent
Femoral hernia
Ventral hernia
Umbilical hernia
Post-operative
Abdominal wall

It is also important to determine and specify the degree of hernia which exists, and the following classification is made:

---

[1] Lauffer, C. A. "Hernia in Industry," *Journal of Industrial Hygiene*, 1919, p. 177.

[2] "Health Service in Industry," *Research Report Number 34*, National Industrial Conference Board, 247 Park Avenue, New York, January, 1921.

First degree:	External ring admits tip of little finger; impulse felt.
Second degree:	External ring admits thumb; protrusion.
Third degree:	External ring patulous; bubonocele.
Fourth degree:	Mass reaches external ring level.
Fifth degree:	Mass scrotal.

As regards cure there is an increasing tendency to have hernia operated on at the expense of industry not only as an insurance against compensation but, also, for the benefit of the worker, himself. The operation is rather simple and with little chance of complications.

XIII

EYES AND TEETH

Eyesight and eye examinations. Extent of eye defects. Occupations subject to strain. Eye testing. Test cards. Estimate of loss of vision. Value of eyesight. Industrial dentistry. Its scope. Inspection. Examination, corrective, and restorative work. Office and equipment. Cost.

THE eyes of the worker have been somewhat neglected, yet they are indispensable in practically all forms of work: "the most valuable of the special senses and frequently the most abused."[1] They are subject to deterioration as well as to injury but have mainly received attention with respect to accidents.

It is quite likely, though no figures are available to support the conclusion, that industry loses far more from subnormal vision than from accidents to the eyes. We know, now, fairly accurately, the extent of eye accidents, and they are serious enough; we have far less knowledge of eye deterioration occurring in, if not from, work. We learn, from a recent investigation made by the National Committee for the Prevention of Blindness, that, "eye accidents surpass all other industrial hazards in seriousness with the single exception of fatal accidents, whether measured from the humanitarian, the cost sheet, or the production standpoint. Approximately 200,000 eye accidents occur in industry annually, and it is estimated that several thousand eyes are permanently blinded as a result."

The Eyesight Conservation Council of America has just completed a comprehensive investigation of industrial eyesight. In an examination of 200,000 workers, the council reports, the average proportion of defective vision is

---

[1] Burch, F. E. "Eyesight Conservation in Industry," *Bulletin Number 359,* Bureau of Labor Statistics, Washington, D. C., May, 1924.

44.3%, and in one group of more than 12,000 employees, the average was as much as 72%. The council has also ascertained that few companies have provided for the examination of the eyes of their employees either as a means of scientific selection at the time of application for employment or as a regular periodic procedure for permanent employees."

THE EXTENT OF EYE DEFECTS IN INDUSTRY

In an examination of 10,000 commercial and industrial workers made by the Life Extension Institute, 53% were found to have uncorrected faulty vision and in a similar study made for the Underwood Typewriter Company 57% were found to be defective and in need of correction by glasses. The following is a summary of the conditions found:

TABLE 44

RESULTS OF EYESIGHT EXAMINATION BY UNDERWOOD TYPEWRITER COMPANY

Particulars	Number	Percentage
Total number examined	675	
Number referred to oculist	391	58.0
Number not referred to oculist	284	42.0
Number in which vision was found normal	80	11.8
Number with slight error, not needing correction	93	13.7
Number with full correction of visual error	111	16.4
Number applying to oculist for examination	409	60.0
Number found in need of glasses by oculist	387	57.3

The General Optical Company found, out of a total of 415 persons, only 126 normal eyes, and the Hood Rubber Company, with 8,338 employees, found 303 who needed corrective treatment for both eyes and a larger number with single defective eyes. Among the 3,000 employees of the Robert Gair Company, manufacturer of paper boxes, an examination showed only 22% had normal vision, 38%

were astigmatic, 28% were hyperopic, 7% were myopic, and 5% were color blind. In a study made of the visual acuity of 6,479 white male industrial workers in various industries it was ascertained that only 60.1% of those between the ages of 30 and 34 had normal vision in both eyes.[1] Finally, in figures furnished to the Eyesight Conservation Council, 29,000 employees of the Ford Motor Company, out of over 60,000 examined, were found to have defective vision, and in the Whiting & Davis Company the following facts were obtained:

No glasses needed	8.4%
Glasses used were satisfactory	8.3%
Glasses were ordered for	83.3%

If these figures are typical, and there is no reason to suppose otherwise, they point to a condition needing serious attention from those who are responsible for production.

OCCUPATIONS SUBJECT TO EYE-STRAIN

G. M. Gould has classified as shown in Table 45 the various occupations according to the frequency of eye-strain.[2] A glance at this table indicates clearly that the chief cause of eye-strain lies in the lighting factor, combined with the fact that practically all close work is indoors and therefore subjects the eyes to the double strain.

Industrial workers are subjected to insufficient lighting, varying intensities of light, glare, shadows, colored and reflected light; they bend over the work, strain the eyes in lifting heavy material, and take up positions too near or too far from their work. Rapid and fine work done on polished surfaces, with lack of contrast and with dusty atmosphere all tend to strain. Some workers do not rest the eyes when they have the opportunity. They spend the

---

[1] Collins, S. D., and Britten, R. H. "Variation in Eyesight at Different Ages, as Determined by the Snellen Test," *Public Health Reports, Number 51,* December 19, 1924.

[2] "The Protection of Eyesight in Industry," International Labour Office, *Report No. 6, Series F,* June, 1923

TABLE 45

FREQUENCY OF EYE-STRAIN IN VARIOUS OCCUPATIONS

Occupations	Percentage of Eye Affections
1. Hunters, fishermen, sailors, farmers, agricultural workers, soldiers, tramway conductors, gardeners, masons, mechanics, chauffeurs, and so forth	1 to 20
2. Sugar refiners, hotel employees, domestic servants, cooks, laundry maids, outside painters, joiners, carpenters, clerks, merchants, and so forth	20 to 40
3. Printers, lithographers, plumbers, coopers, foundry workers, metal workers, zinc workers, lead workers, paper makers, and so forth	40 to 60
4. Bakers, electricians, hatters, shoemakers, glovemakers, dressmakers, weavers, polishers, binders, musicians, telegraphers, miners, tunnel workers, caisson workers, chemists, scholars, housekeepers, and so forth	60 to 80
5. Students, priests, lawyers, office clerks, reporters, teachers, hair dressers, shorthand typists, draughtsmen, embroiderers, photographers, tailors, cigar makers, engravers, watchmakers, and so forth	80 to 100

night at home reading, or keep late hours and get insufficient sleep, thus making them more susceptible to the effects of factory work. Whatever the cause there is the need to place workers in the position in which they can do their best work and this includes not only a knowledge of the condition of the person's eyesight but also the character of the work to which he is assigned.

EYE TESTING

The object of eye testing is to see that a man has enough vision for a specific occupation, to reveal the presence of defective vision, to ascertain symptoms of defects, and sometimes to measure errors of refraction.

The first requisite is to have a private room not less than 22 feet long in which each person may be tested separately. The room must have subdued light and adequate ventilation and be equipped with a luminous test chart and refracting chair. The tests to be made are generally for nearsightedness and farsightedness. The direct purpose of the test is to ascertain visual acuity which is the extreme limit of power to perceive a certain object distinctly. In the test normal vision is the ability to see a certain standard object (test type) clearly at a specified distance. In ascertaining a person's visual acuity the eye should be 20 feet from the test type in the horizontal, and each eye should be tested separately, the left eye being tested while the right eye is covered and right eye being covered while the left eye is being tested.

The test card consists of a series of types oi various sizes to be read from the top of the card downwards and the degree of visual acuity is determined by the smallest letters that can be deciphered by the eyes at a distance of 20 feet from the chart. A person who is able to read the standard type at 20 feet is said to have normal vision and the fact is recorded as 20/20; that is, at 20 feet he read the test type specified for that distance. If he is unable to read the 20-foot line but can read the 30-foot line his vision is said to be 20/30, and so on. It is obvious that 20/30, therefore, is not a fraction and not two-thirds vision as is sometimes supposed.[1]

In calculating the percentage loss of vision in industry, the scale given in Table 46 has been suggested.

A man may have normal vision for distance yet his eyes may be defective for close work. In order to test for nearsightedness the "Near Test Card" may be used and there must be a knowledge of the distance between the eyes and the work for each specific test, that is, the "working distance." The "Near Test Card" contains numbers at

---

[1] "Eye Tests in Industry," *Eyesight Conservation Bulletin No. 3,* The Eyesight Conservation Council, Times Building, New York.

TABLE 46

SCALE FOR DETERMINING PERCENTAGE LOSS OF VISION

Tests	Percentage Vision	Percentage Loss
20/20	100	0
20/30	95	5
20/40	90	10
20/50	85	15
20/60	80	20
20/70	75	25
20/80	70	30
20/90	65	35
20/100	60	40

the right of each line of type indicating the distance in inches at which each should be read.

The worker places the test card at the "working distance" by measurement, and reads the smallest letters that can be seen. In recording the test, the working distance is used as the numerator and the denominator is the number opposite the line of the smallest letters read. In testing for nearsightedness job specifications may be utilized to record the working distance in each case.

Several courses may be adopted in dealing with the subject of faulty vision. The first is to have the medical department examine all persons, both applicants and employees, in order to be in a position to place them in jobs suitable to the condition of their sight, or reject those who do not come up to a specified standard. Another plan is to secure the services of an oculist, generally on part time, who will ascertain those who require glasses, and prescribe for them. The usual plan is for the employer to pay the oculist and carry the overhead cost of light, heat, and rent and for the worker either to get his prescription filled where he prefers at his own cost, or for the employer to get the work done wholesale, in which case the worker is charged cost and the amount deducted from the pay-roll in small weekly payments as agreed. When glasses are purchased in large quantities the cost to the individual is perhaps reduced by half, and "twelve minutes is ample time in any one case to ascertain whether glasses are needed or not"; [1] and thereby the length of the time to be occupied by an optometrist can be estimated. An employer who only furnishes employees with prescriptions for glasses need not be disappointed if the workers do not get the prescriptions filled. They usually cost more than the worker can afford; hence, the best arrangement is an agreement to share the cost equally and have the employer contract for the work at wholesale rates.

There is hardly any doubt but that a great deal of attention will be given to the matter of eyes in industry in the next decade. We are in a position at present where little proof can be offered as to the advantage of improving industrial eyesight. It is obvious, however, that better sight would increase the comfort and efficiency of many workers, that production would increase both in quality and quantity, that waste would be avoided and that the number of accidents would be reduced. When a plant manager declares that his smelter foreman, whose sight is failing, could not be replaced for $10,000, it is obvious that the care of eyesight may mean a great saving. In the Whiting & Davis Company, after the staff had been provided with glasses, production at once increased 28.03% and the workers kept more steadily at their tasks, so that the entire morale of the working force was strengthened.[2] A few other companies are able to testify to the same effect.

INDUSTRIAL DENTISTRY

Perhaps no more than 10 workers in every hundred have good teeth and, in some groups of employees, conditions are even worse. Teeth have no direct effect on production but maintenance of general health often depends on good teeth. Many ailments are traceable to decayed teeth; they make proper mastication of the food impossible, thus increasing indigestion and other stomach troubles which are quite prevalent among workers. No less an authority than Sir William Osler said, "There is no one single thing in preventive medicine that equals mouth hygiene and the preservation of the teeth," and Charles H. Mayo, the great Rochester surgeon, states that, "The next greatest step in medical progress in preventive medicine should be made by the dentist." Diseased teeth are the obscure cause of some sicknesses; they distribute bacilli of low virulence unsuspectedly through the system and cause, in consequence, many systemic disorders of the heart, joints, and nervous system.

---

[1] Brown, Hal. "Corrected Eyesight," *Factory*, July 1, 1920, p. 55.

[2] Ryer, E. LeR., and Fisher, W. B. "Better Work and More Work per Man through Better Sight," *Industrial Management*, February, 1922, p. 111.

Employees, as a rule, are profoundly careless of their teeth and the only thing that saves the situation in many instances is that few are indifferent to appearances, and consequently some effort is made to keep the visible teeth free from decay. When the Metropolitan Life Insurance Company first examined its own employees, it found that 2,002 persons had 9,138 cavities, and 1,230 badly decayed teeth, or an average of 0.6 a person. This group had lost 9,320 teeth, or an average of 4.7 per individual, and many other conditions were found to need attention.

Bad teeth arise from a variety of causes. Sometimes the worker knows nothing of hygiene of the mouth; sometimes he is aware of the importance of dental work but cannot afford it; and occasionally, he has cheap work done without any permanent improvement. The object of bringing dental work into industry is to lay the foundation of good health.

The growth of industrial dentistry has been rapid. The first dental department was started hardly more than a decade ago and in 1921 no less than 150 companies were doing some kind of dental work. In an investigation made by the Pennsylvania State Department of Labor, in 1923, it was found that, out of 59 plants replying, no less than

40 had full-time dentists employed, and there were 71 full-time dentists in all, serving 116,983 employees.

Many types of dental work are to be found in industry, ranging from the mere inspection of teeth to full care without cost. In the course of the physical examination it is usual to inspect the teeth and, in some cases, practical advice is given as to the care of the mouth. A less elementary form of oral hygiene is the giving of minor prophylactic treatment, including cleaning of the teeth. A further development is that of filling and extraction.

Outside dentists are sometimes allowed to work in the plant as a matter of convenience, getting their regular fees from the worker, but usually dentists are hired by the employer on a whole- or part-time basis. In some instances the employer bears all the cost, in others the cost is shared, but generally the employee pays the cost of special work. Occasionally dentistry is done through the mutual aid association in which the employer and employee share the cost equally, and there are instances where employees themselves have established a cooperative dental clinic on a self-supporting basis. In Milwaukee an industrial dental clinic furnishes work to large industrial concerns and dentists are sent from its offices to the factories at certain specified hours.

THE SCOPE OF INDUSTRIAL DENTISTRY

The principal phases of industrial dentistry are inspection, examination and advice, emergency, corrective, restorative, and educational work.

The purpose of inspection is to ascertain the condition of the mouth of the applicant in order to select only healthy persons for employment. The number of loose and missing teeth, the condition of the remaining teeth and gums, the general condition of the mouth and local infections are ascertained. Rejection is based on the lack of serviceable masticating teeth or on an infected condition and general lack of hygiene not easily corrected.

TABLE 47

ANALYSIS OF DENTAL WORK DONE BY 56 FIRMS

Character of Treatment Given	Number	Percentage
Cleaning	54	96.4
Radiographic work	25	44.6
Emergency treatment	50	89.3
Operative work not emergency work	36	64.3
Examination and cleaning only	1	1.8
Examination, cleaning and radiographic work	2	3.6
Examination, cleaning and emergency work	9	16.1
Examination, cleaning and operative, not emergency work	2	3.6
Examination, cleaning, radiographic and emergency work	5	8.9
Examination, cleaning, emergency and operative work	18	32.1
Examination, cleaning, radiographic, emergency, and operative work not emergency work	17	30.4
Examination, radiographic and emergency work	1	1.8

The oral examination is for the purpose of giving advice as to the conditions ascertained and to explain the principles of mouth hygiene. It includes, also, the taking of x-ray pictures in suspicious cases and, later, explanation of the findings.

Corrective and restorative work includes the cleaning and filling of the teeth, in case of pulp exposure.

Relief of pain, tooth extraction, opening of abscesses, and the filling of small cavities are the principal features of emergency work. Efforts are made to determine the cause of the conditions and to give suitable advice as to cure.

Education on oral hygiene is an important feature of preventive work and should be carried on even where no dental work is done. It is considerably better than nothing at all. It consists of individual instruction given in the dental room during examination and general education by means of leaflets, pamphlets, articles in the plant periodical and in occasional talks and lectures on the subject of health maintenance.

An interesting cross-section of industrial dentistry is given in the analysis of 56 firms made by the Pennsylvania Department of Labor in 1923, as presented in Table 47, on the preceding page.

It will be seen, from an examination of the figures in Table 47, that cleaning, as a prophylactic measure, is one of the commonest forms of industrial dentistry in Pennsylvania and probably this is true of industry in general.

A summary of the work done in 18 different dental dis-

TABLE 48

WORK DONE IN 18 DENTAL DISPENSARIES FOR 1923

Kind of Work	Number	Totals Number	Totals Percentage
Examinations		6,800	30.5
Accepted applicants	2,000		
Employees	4,800		
Fillings		2,760	12.3
Amalgam	1,550		
Cement	475		
Gutta percha	650		
Synthetic porcelain	75		
Gold inlay	20		
Pulps		150	.7
Capped	40		
Removed	110		
Canals		505	2.2
Dressed	420		
Filled	85		
Treatments		5,015	22.5
Pyorrhea	865		
Pulpitis	670		
Percimentitis	75		
Alveolar abscess, acute	300		
Alveolar abscess, chronic	270		
Gingivitis	340		
Stomatitis	125		
Prophylaxis	2,370		
Extractions		1,675	7.6
Local anesthesia	955		
General anesthesia	720		
X-Ray cases		2,060	9.2
Miscellaneous		3,345	15.0
Total		22,310	100.0

pensaries for the year 1923 is reported by Dr. Ralph W. Elliott and given in Table 48, on the opposite page.[1]

Apart from the routine examination of applicants and employees it will be seen that dental work consists principally of fillings and prophylactic treatments.

The following are a few typical descriptions of industrial dental work.

THE NATIONAL CASH REGISTER COMPANY. DAYTON, OHIO

All applicants for employment are sent to us for a dental examination and they are then sent to the medical department, where a record is kept of the dental and medical examinations. We give each applicant a chart with all decayed teeth marked and urge him to have them filled at once. If we find diseased teeth and broken down roots in the mouth, we invite them to the office to have them extracted or send them to their dentist. We do not reject anybody from employment on account of their teeth unless we find something specific or malignant in the mouth.

Our work consists of examinations, first-aid treatments, temporary fillings, extractions, prophylaxis, and X-Ray diagnosis. We do extraction by infiltration only; all other cases are referred. Every employee is entitled to have his teeth cleaned every six months, although it is not compulsory. There are no charges for any work in the dental dispensary and all work is done on time of the company. In the majority of the cases prophylaxis is very much needed. We find that the employees are very appreciative of the services rendered.[2]

AMERICAN CAST IRON PIPE COMPANY

The company employs a dentist for full time. He goes on duty at 8 a.m. and stays till 5 p.m. Everything is done for the working man in the way of dentistry. Alloy fillings, cement, extractions, cleaning, and so forth, are all free. Gold fillings, plate and bridge work are charged, or, rather, a fee is charged to about cover the cost of material. They have the privilege of having this done on company time. The families enjoy the same privilege. This fee is deducted in small payments as the men wish, each week, until the amount is paid. The company feels that the dental department is one of the main legs of the medical department; it saves the time lost in going to a dentist in the city, which works a hardship both on the company and the men. . . .[1]

---

[1] Elliott, Ralph W. "Scope of Work in an Industrial Dental Clinic," *The Nation's Health,* January, 1924, p. 7.

[2] Discussion, by H. M. Brewer, at the National Dental Association Meeting, Boston, Massachusetts, 1920.

THE ORGANIZATION OF A DENTAL DEPARTMENT

The introduction of dentistry generally depends on the prior existence of a medical department and on the conditions ascertained by physical examination. Having decided on a plan, as determined by a statistical analysis of the dental needs of the workers, and usually consisting of general prophylaxis and cleaning, an announcement, such as the following may be made:

> In response to the wishes of some of our employees for dental treatment, and our own desire for their health improvement, we have secured the services of a qualified dentist. Employees desiring examination or work at cost may arrange for a sitting through the foreman. No charge is made for examination and advice. Work may be done on company time.

The general plan is to have the dental department independent of, though closely associated with, the medical department, of which it is naturally a part, and with which there should be the closest cooperation. The number and character of the staff is determined by the kind and extent of the work to be done. Usually there is, in the larger organizations, a dental director, with dental hygienists engaged at prophylactic work under his supervision. In the Heinz Company, of Pittsburgh, with 2,000 employees, one full-time dentist makes 1,200 examinations a year. The J. G. Brill Company, with 1,500 employees, has a dentist for 12 hours a week. The amount of work to be done in the beginning is considerably greater than when the effects of prophylactic work begin to be felt. The number of examinations, of course, depends on the number of applicants and employees.

---

[1] Bray, C. B. "Dentistry, a Phase of Medical Service," *Modern Medicine,* January, 1920, p. 51.

The duties of the dental staff consist principally of the routine examination of applicants and employees. A record is made of all the work done and, in the case of applicants, of future work, both for the office and for the employee's own information. The staff takes care of all emergency work as it occurs and fills in its unoccupied time making periodic re-examinations for which arrangements are made with the foremen, in order to avoid disruption of work as much as possible.

Consultations between the dental, medical, and employment departments on new cases examined is part of the daily routine. Dental assistants or hygienists relieve the dentist of routine work by doing the charting and clerical work and in the maintenance and sterilization of equipment.

Payment of the full-time staff is usually on a salary basis. Part-time dentists may be paid at so much per case or per hour. In some cases, however, dentists are permitted to make appointments for plate, crown, and bridge work in their own offices at regular rates outside business hours in order to supplement their income. Since plant dentistry is large in volume there should be a substantial reduction in cost for special work in order that the employee may be able to afford it.

THE DENTAL OFFICE AND EQUIPMENT

The dental office is usually next the physical examination room and the waiting-room is used in common in order to economize space. A room 8 by 10 is ample in small plants and in larger plants the dental service may be increased by units of the same size. Each unit is equipped with a cabinet, chair, file, gas-oxygen outfit, and the small tools and appliances for extraction and prophylaxis at a cost of about $2,500. The Metropolitan Life Insurance Company, with 5,000 employees in 1915, equipped its dental department with the following instruments and apparatus:

Four S. S. White Evans-Forsythe Dental Units, consisting of chair, bracket, engine, cuspidor, and compressed air attachments;
Four S. S. White Lyons operating tools;
Four electric spray heaters;
One Ritter Columbia dental chair;
One Ritter dental engine;
One electro-dental switchboard;
One Waugh radiographic machine and lead screen;
Two sterilizer outfits;
Four small cabinets;
One large dental cabinet;
One metal and glass linen cabinet;
Complete set of instruments, towels, bibs, and so forth.

The National Electric Lamp Works of the General Electric Company sums its experience thus: "We soon discovered that the usual dental equipment did not adapt itself to the requirements of the industrial dispensary and were obliged to design special instruments and apparatus."

In the Metropolitan Life Insurance Company the cost of the entire dental service was $7,229, or an average of $3 per hour, and an average per patient of $2.33. The cost for prophylactic work was $2.46 per patient and $1.06 for emergency work.[1] The following figures give the principal items of cost for the company in the years 1916 and 1917.

Item	1916	1917
Equipment	$ 1,087.41	$ 320.30
Supplies	1,585.97	2,106.63
Salaries	13,812.75	14,201.01
	$16,486.13	$16,627.94

"The gross operating cost of a dental dispensary in a concern employing 1,600 persons, including dentist's salary, insurance, depreciation, interest and cost of materials, was $1,510.78. The receipts for the same period were $1,230.75. The actual cost to the company was $280.03, or $23 per month."[1] In the Pennsylvania enquiry 27 firms had an average cost per patient per year of $3.38, while the average cost of equipment was almost $2,000 among 53 plants.

---

[1] Frankel, L. K. "Dental Work in Industries," *Fifth Annual Safety Congress*, October 19, 1916.

Details as to the operation of dental departments vary. The Crane Company, of Chicago, the Norton Company, of Worcester, Massachusetts, make dental work compulsory. The Heinz Company, the National Cash Register Company, and the Joseph & Feiss Company, of Cleveland, make dentistry voluntary. In the latter case, however, employees are urged, in various ways, to have their dental needs attended to.

A dental inspection at entrance is almost invariable in the plants where physical examinations are made, but only in a few cases are the findings subject to re-inspection. The time of attendance is guided by the availability of the worker and the dentist, particularly in part-time work. Part-time varies in length from one hour a day to a full day or two at a time. In one factory the dentist spends an hour each day in the plant assisted by a nurse, and treats an average of 11 patients in that time. The J. B. Stetson Company, of Philadelphia, has a dentist four mornings a week, beginning at 9 a.m.

Thirty-three plants, employing 209,743 persons, reported that the number of their employees taking dental treatment was 125,222, or 59.7% of the total. The volume of dental work, however, varies. It is usually much larger at the start than afterwards.

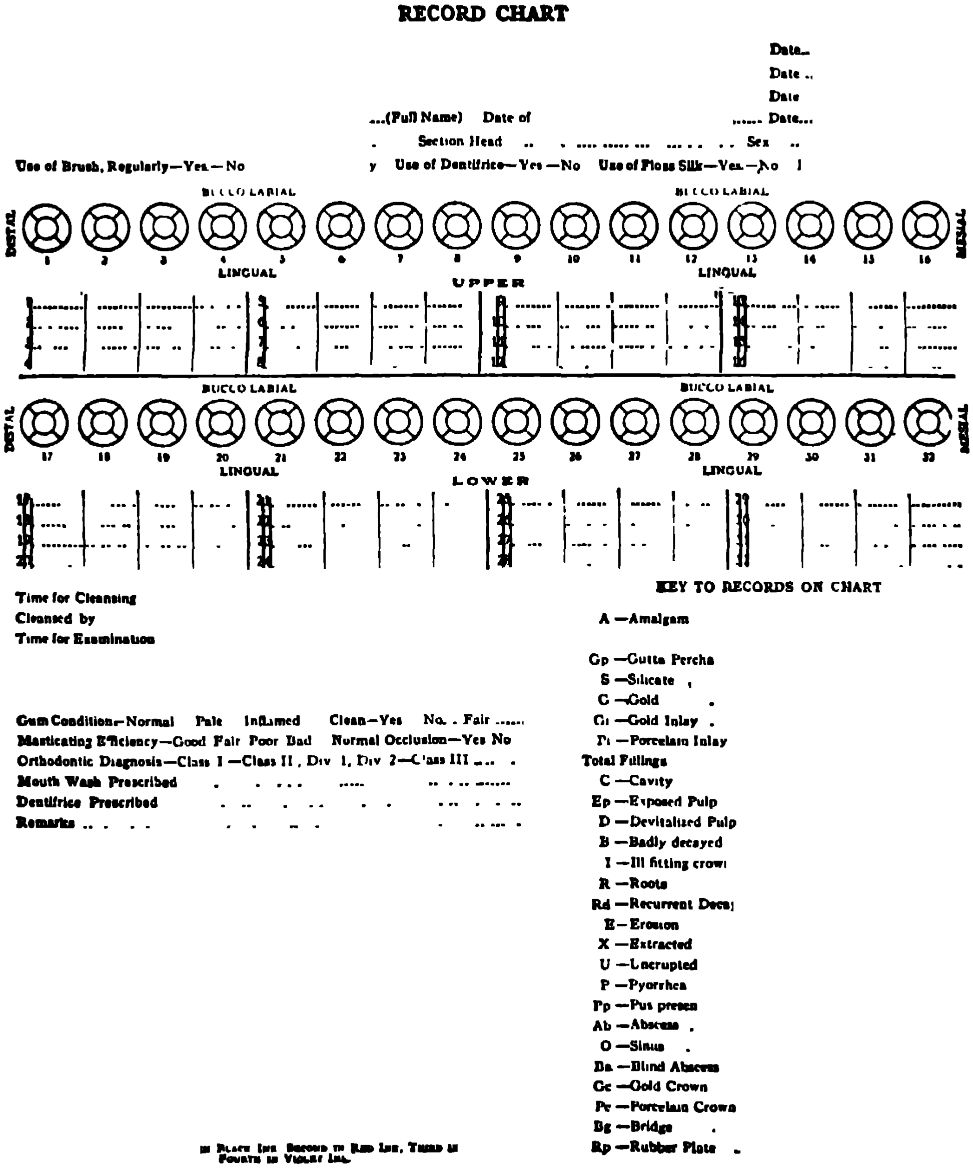
> Six or seven years ago the factory executive was decidedly dubious in regard to dental service. Today, as our manager said to me: "We are reaping the harvest of five years' work. Then 83% of our employees were in need of major dental work; now less than 8% require any form of dental care other than periodic cleaning. We rarely see any emergency work, and even then only among recent employees."[2]

---

[1] DeHart, Sanford. "Dentistry for the Worker," *Dodge Idea*, January, 1923, p. 10.

[2] Elliott, R. W. "Scope of Work in an Industrial Dental Clinic," *The Nation's Health*, January, 1924.

In the operation of the dental department the employee goes from his work with the permission of the foreman for examination. The dentist makes a note on the card what work is required, estimates cost, and gives the employee choice as to work to be done. After the examination the employee's card is placed on a waiting list and he is notified when to attend.


BUCCO LABIAL
BUCCO LABIAL
DISTAL
MESIAL
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
LINGUAL
LINGUAL
UPPER
BUCCO LABIAL
BUCCO LABIAL
DISTAL
MESIAL
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
LINGUAL
LINGUAL
LOWER

RECORD CHART

Date..
Date ..
Date
...(Full Name) Date of ...... Date...
Section Head .. Sex ..
Use of Brush, Regularly—Yes—No
Use of Dentifrice—Yes—No Use of Floss Silk—Yes—No

Time for Cleansing
Cleansed by
Time for Examination

Gum Condition—Normal Pale Inflamed Clean—Yes No. . Fair ......
Masticating Efficiency—Good Fair Poor Bad Normal Occlusion—Yes No
Orthodontic Diagnosis—Class I—Class II, Div 1, Div 2—Class III ....
Mouth Wash Prescribed
Dentifrice Prescribed
Remarks

KEY TO RECORDS ON CHART

A —Amalgam
Gp —Gutta Percha
S —Silicate
G —Gold
Gi —Gold Inlay
Pi —Porcelain Inlay
Total Fillings
C —Cavity
Ep —Exposed Pulp
D —Devitalized Pulp
B —Badly decayed
I —Ill fitting crow
R —Roots
Rd —Recurrent Deca
E—Erosion
X —Extracted
U —Unerupted
P —Pyorrhea
Pp —Pus presen
Ab —Abscess
O —Sinus
Ba —Blind Abscess
Gc —Gold Crown
Pc —Porcelain Crown
Bg —Bridge
Rp —Rubber Plate

[illegible] Black Ink Second in Red Ink, Third in
Fourth in Violet Ink.

Figure 7: Form used for recording dental examinations

Usually compulsory dental work is done without charge as in the case of the Metropolitan Life Insurance Company, the National Electric Lamp Works, and the John Wanamaker Store in New York. Compulsion practically involves free treatment. Those who make a charge do so on the grounds that workers do not like accepting charity from the employer. Practically all companies give advice free and most firms give treatment at nominal cost. The Montgomery Ward Company gives advice and emergency work free but charges cost of dentists' time for all other work. Another company charges new employees and makes a refund after six months' service, all the work being done on company time. The American Pulley Company deducts time spent in the dental office from workers except in the case of emergency, examination, and cleaning. Charges are entered on a card and the duplicate goes to the pay office.

In the Pennsylvania enquiry, 57 firms gave information as to the cost of operation, as follows:

TABLE 49

COST OF OPERATION OF DENTAL DEPARTMENT

Particulars	Number	Percentage
Employers bearing entire cost	32	56.1
Cost shared between employer and employee	25	43.9
Employers pay 75% or more of cost	33	57.9
Employers pay 50% to 74% of the cost	10	17.5
Employers pay 25% to 49% of the cost	..	...
Employer pays less than 25% of the cost	1	1.8
Proportion paid unknown	13	22.8

Educational work is an important phase of dental improvement. The National Cash Register Company gives lectures on the benefit of oral hygiene and of periodical dental prophylaxis and also distributes bulletins on the care of the teeth. Another company gives photographic illustrations of the need for dental work and the National Safety Council has issued a series of posters on "Good Teeth—

Good Health." The plant periodical is used in a number of cases to advertise dental work and also to point out the advantages of good teeth.

On the whole, dental work in industry may be considered a success. It saves the worker cost and improves his health and probably reduces the amount of absentism materially. When there is no dentist in a plant a worker with a pain in his tooth stays home or spends two or three hours going to an outside dentist and gets work done at a high rate and often of inferior quality.

HEALTH MAINTENANCE IN INDUSTRY

PART III

THE SURGICAL DEPARTMENT

XIV

SURGICAL AND FIRST-AID TREATMENT

Sickness and accidents compared. Relative gravity of injuries. Surgical treatment. First-aid organization. First-aid room. Equipment. Standardization. Extent, cause, and prevention of infections. First-aid training. Medical and surgical costs.

The surgical department, under the influence of various workmen's compensation acts, has won for itself an established place in industry. It aims to do for the injured worker what the medical department does for the sick. It is, as is medical service, essentially first-aid in character except in the very large or isolated plants.

Prompt and efficient surgical work saves the employer money, reduces human suffering, maintains the morale of the injured worker, and restores him to work without delay. Inadequate or tardy treatment of injuries leads to infection and lost time, involves the employer in much increased sums for compensation, and often seriously reduces the worker's capacity to produce.

The relative importance of industrial surgery has decreased in the last few years; first, because improved methods of accident prevention have reduced its volume and, secondly, because the medical care of the worker has received increased attention. It is now not unusual to find that the medical cases exceed the surgical cases in number, quite considerably. As long as there is surgical work to be done, however, it will always demand serious attention. Neglect of the injured worker has led to much trouble in the past. It has been the cause of much costly litigation, has provided a fruitful source of grievance, and has created untold resentment among workers.

Out of 376 concerns investigated by the United States

Department of Labor in 1918, 110 were found to have first-aid only. Of these, 77 had first-aid kits; 16 had first-aid cabinets and stretcher or cot, and 12 had first-aid kits in the rest-room.

Industrial surgery should be adequate to give the most efficient first-aid treatment in case of any injury, no matter how unusual in character, since it is essentially an emergency service. Usually it consists of the treatment of slight wounds of various kinds, but there may be occasional fractures, joint injuries, ruptures, and nerve or visceral injuries. Preparation should be made to deal with the following:

Minor injuries
Fractures
Sprains
Bruises
Faintness
Shock
Burns
Hemorrhages
Sunstroke
Frostbite
Drowning

Most industrial surgical work, though minor in character, is nevertheless highly important. It must always be remembered that the foundation of successful industrial surgery is that each minor injury should receive major consideration. The relative gravity of industrial injuries is shown by the following figures:

TABLE 50

RELATIVE GRAVITY OF INDUSTRIAL INJURIES

Character of Injury	Number	Percentage
Severe	43	1.2
Moderate	117	3.3
Slight	3,387	95.5

The above figures clearly show the preponderating number of slight injuries. Unless minute attention is paid to them the surgical work in a plant must be a failure; many of the wounds, originally slight, will develop infections and the number of severe cases will increase. The great test of good surgical service is the absence of infections.

The object of surgical work in industry is at once humane and economic. The worker must first be relieved of pain and then cured, but he must also be returned to work at the earliest possible moment and without loss of function. The alert surgeon, desirous of expanding his field, will often find occasion to step out of his strict sphere and take part in accident prevention or cooperate with those who have this duty. The surgeon is at once a technician and a teacher. He cannot always be on the spot when accidents happen and he must, therefore, provide himself with efficient deputies to do the right thing at the right time. This involves a system of training in first-aid principles and the establishment of standardized methods of treatment wherever possible. Another not unimportant duty is the prevention of injury by the exclusion of the physically unfit, the mentally unbalanced, and the syphilitic applicant in conjunction with the medical and employment departments.

The surgeon may also perform an important service in the administration of the workmen's compensation acts by gathering full and accurate information as to all the circumstances surrounding the accident as well as the nature and extent of the injury itself. Though obviously a "company man," in the sense that he is paid by the employer, the doctor stands midway between him and the worker and is, thereby, in a position to understand both sides of a question and act accordingly.

Industrial surgery is the same as any other kind of surgery except that its application and purpose are somewhat different. While aiming to relieve pain and cure the injured worker the surgeon must keep the industrial viewpoint steadily in mind. Therefore, the cure must be prompt and involve no permanent impairment if it can be avoided. Surgical treatment must be immediate, continuous, and of the proper character.

Treatment cannot be immediate if the surgeon is absent or has failed to provide an adequate number of first-aiders. Workers know, from actual experience, that slight wounds do not necessarily involve infection, and it takes much training and vigilance to make them seek prompt treatment for slight wounds. It is part of the surgeon's duty, also, to persuade foremen to insist that their men shall seek first-aid even in the case of the slightest wound.

While the scope of surgical work varies, there is no variation from the principle that the future must be guided by past experience. The first move, therefore, is to make an exhaustive analysis of past accident experience for the purpose of organizing methods of treatment as well as prevention. A comprehensive knowledge of injuries received, as shown by accident reports, provides the necessary data for establishing a surgery, its staff and equipment, the amount, character and placement of the latter and the nature and extent of the first-aid training. Departmental tabulation of accident shows those places, occupations, and jobs where accidents are likely to occur.

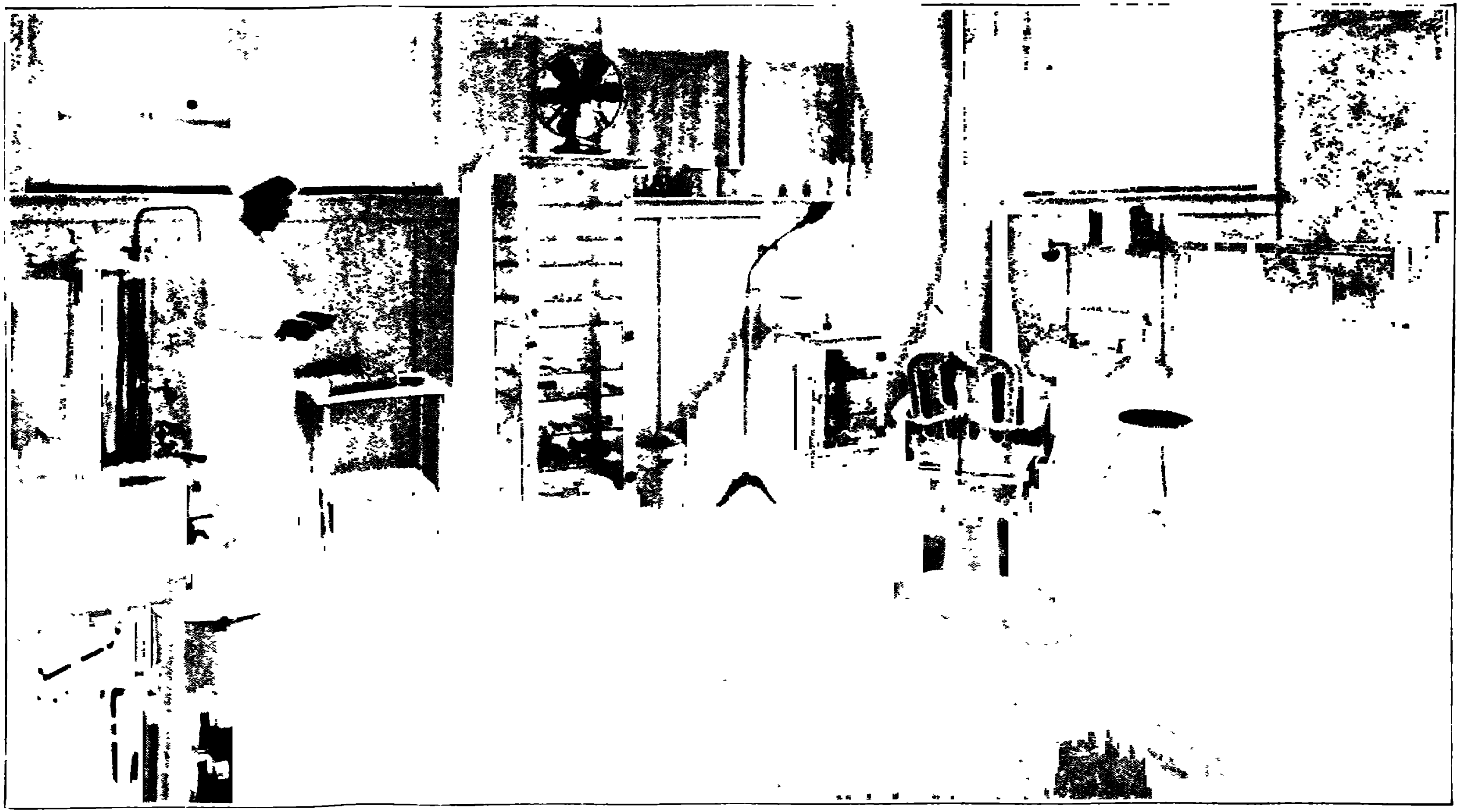
The J. I. Case Threshing Machine Company, for instance, gave the following service between August and October, 1919:

Lacerations	716	Emery wounds	40
Eyes	669	Strains	23
Abrasions	462	Scalp wounds	19
Contusions	230	Infections	6
Slivers	122	Finger amputations	2
Punctures	53	Redressings	3,323

The surgeon should endeavor to inspect and treat every injury himself since that is what he is paid for. Where that cannot be done, the use of trained substitutes is not only permissible but commendable. This throws upon the doctor the responsibility for selecting and training a sufficient number of first-aiders and providing them with adequate equipment in convenient locations.

FIRST-AID ORGANIZATION

In the large plants there is a central hospital where first-aid is given in important injuries and, throughout the plant, at convenient points, are stations where first-aid is received



Courtesy Champion Coated Paper Company, New York

Figure 8 Interior view of first-aid room

either before going to the main hospital or returning to work in case of slight injuries.

An alternative to the substation plan is to have kits placed in the departments themselves with competent men to use them. In all cases the worker with an injury of any importance is inspected by the doctor in charge or by a fully qualified nurse till the doctor can be reached. First-aid kits should be placed in departments only when the doctor cannot be reached readily.

The size of the plant and the relative frequency and severity of injuries determine the form and extent of the first-aid organization. Whether in the main hospital or as a substation the first-aid room may be considered as a unit and there should be one in every plant employing a hundred or more employees. Either the doctor or a fully qualified nurse should be in attendance during work in plants with 500 employees or over. If the plant covers a wide area, however, first-aid should be supplemented by a committee of workers in each outlying department who undertake to care for the first-aid kits and who are responsible for keeping them in order and seeing that only those who are properly trained shall be allowed to handle the boxes and administer first-aid. If possible those who assume this responsibility should have a first-aid certificate and receive their training from the plant surgeon.

THE FIRST-AID ROOM

First-aid obtained legal status in Massachusetts on the passage of a law in May, 1919, providing that all plants within the state employing 100 persons or more shall have an emergency room. Such a room is placed in a "convenient location," that is to say, as near where accidents are likely to occur as possible, so that workers can find it without difficulty or delay. Such a room should be private to assure the comfort of the injured and conditions favorable for proper treatment. The size of the emergency room should be somewhat as follows:

TABLE 51

SIZE OF EMERGENCY ROOM

Number of Employees	Size, Feet
500	9 by 12
1,000	10 by 15
1,500	12 by 15
2,000	14 by 15

The essential feature of an emergency or first-aid room is the surgical unit which should be sufficient for plants employing 1,000 persons and may be duplicated according to requirements, each unit being separated by a screen.

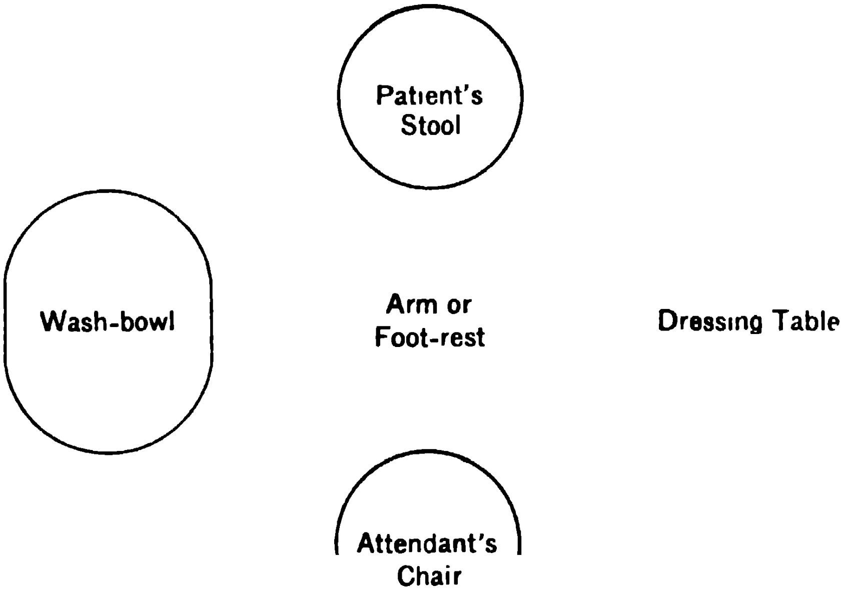


Figure 9: Dressing unit

The surgical unit consists of an attendant's chair, the patient's stool, a dressing table, an arm- or foot-rest, and a wash-bowl, arranged according to the above plan.

The Carnegie Steel Company provides the following standard list of equipment for its dressing rooms:

1 surgical scissors, 5½ inches, straight
1 surgical scissors, 5½ inches, curved
1 bandage scissors, 7 inches
2 scalpels and 1 curved bistoury in case
1 tissue forceps, 5 inches
1 thumb forceps, 5 inches
3 hemostatic forceps, Kelly's
2 wound probes, 5 inches
1 grooved director
12 assorted needles
1 Mathieu's 5-inch needle holder
1 eye spud
1 magnifying lens
1 United States Army field tourniquet
24 safety pins
12 emergency tubes of catgut with needles
12 aseptic wormgut ligatures
12 envelopes Red-Cross catgut, assorted
12 reels of silk, assorted
1 hypodermic syringe in case, military type
3 wound syringes
1 white enameled pus basin, 10 inches, kidney shape
1 white enameled deep basin, 10¼ inches
1 white enameled instrument tray, 9½ inches
12 yucca wood splints, 4 x 18 inches
24 internal angular wood splints, assorted
24 bond splints, right and left
24 gauze bandages, 2 inches
24 gauge bandages, 3 inches
12 muslin bandages, 3 inches
12 one-yard packages plain gauze
1 pound absorbent cotton, in 4-ounce packages
6 eye-droppers
1 white enameled medicine container
1 clinical thermometer
1 pair rubber gloves
1 box wooden tongue depressors
1 safety razor and blades
1 hair clipper
1 mouth gag
4 ounces tincture of iodine

4 ounces carbolic acid
4 ounces alcohol
4 ounces tincture of green soap
4 ounces aromatic spirits of ammonia
4 ounces collodion
8 ounces boracic acid ointment
½ an ounce aristol
8 ounces petroleum
1 tube ethyl chloride
20 ounces creolin
8 ounces boracic acid
½ gallon alcohol
1 medicine glass, graduated
1 hand brush

The National Affiliated Safety Organizations have designed a standard first-aid jar to be used in the case of emergencies where the first-aid room is not immediately accessible. Its contents are as follows:

(*a*) Tourniquet
(*b*) Nickel-plated scissors
(*c*) Tweezers, nickel-plated
(*d*) Triangular sling
(*e*) Wire gauze splint
(*f*) Safety pins, 1 dozen, assorted
(*g*) Castor oil, 2 ounces
(*h*) Burn ointment, 3-ounce tube
(*i*) Iodine tincture, 2 ounces, 3%
(*j*) Vinegar, 2 ounces
(*k*) Boric acid solution, 2 ounces
(*l*) Aromatic ammonia, 2 ounces
(*m*) Jamaica ginger, 2 ounces
(*n*) Flannel, 24 by 36 inches
(*o*) Absorbent cotton, 1½ ounces
(*p*) Gauze bandage, 3 inches by 10 yards
(*q*) Gauze bandage, 2 inches by 10 yards
(*r*) Gauze bandage, 1 inch by 10 yards, two
(*s*) Adhesive plaster, 5 yards 1 inch
(*t*) Sterile gauze, 6 by 36 inches, 6 packs
(*u*) Teaspoon
(*v*) Metal cup
(*w*) Medicine glass, graduated
(*x*) Medicine droppers, two
(*y*) Paper drinking cups, three
(*z*) First-aid record cards

When a slight accident occurs the patient is seen immediately by the first-aider, who merely applies sterile dressing after the application of iodine or other antiseptic. If no further treatment is necessary the injured returns to work, otherwise he is sent to the plant hospital.

In serious accidents hemorrhages are stopped, sterile dressings are applied, and the patient is accompanied to the emergency room if able to walk. It is generally advisable, however, to telephone for the nurse, who comes with a stretcher and takes charge until the arrival of the doctor.

In cases where the nature of the injury necessitates absence from the department for treatment, the foreman may issue a pass stamped with the time of departure. After treatment the card is again stamped, and the worker returns to his job. The treatment card indicates when the worker should return for re-treatment and it serves to notify the foreman when the worker expects to be absent.

FIRST-AID STANDARDIZATION

Since the vast number of injuries are of only a few types it is advisable to adopt some standard methods of treatment. Variation in the method of treatment at different times and by the same person creates an unfavorable impression among workers who are unaware that one method may be as good as another. For that reason and, also, for the purpose of saving time and making training more effective the doctor will find some scheme of standardization advisable. Difference of opinion may arise as to which method is best, but the doctor should use some one method consistently.

The Conference Board of Physicians in Industry has suggested the following:

STANDARDIZED FIRST-AID TREATMENT OF INJURED PERSONS [1]

1. Treatment of injuries which do not bleed (such as contusions and sprains):
   (*a*) Use several layers of sterile gauze or cotton, placed directly on the injured part.
   (*b*) Apply bandage; use nothing else.
   (*c*) Place the patient at rest and elevate the injured part.
2. Treatment of injuries in which the skin is broken:
   (*a*) Drop into the wound a 3% alcoholic iodine solution. Use it freely but do not use it on the dressing.
   (*b*) Apply a sterile gauze compress and bandage.

---

[1] "Health Service in Industry," *Research Report Number 34*, January, 1921, National Industrial Conference Board.

(*c*) In case of excessive bleeding, proceed as under "Treatment of Hemorrhage."

3. Treatment of Hemorrhage:
   (*a*) Place the patient at rest and elevate the injured part.
   (*b*) Place a pad of sterile gauze over the bleeding spot, large enough so that pressure can be applied above, over, and below the wound.
   (*c*) If bleeding does not stop, apply a tourniquet between the wound and the heart, using for this purpose a belt, shoe string, cord or suspender if regular tourniquet is not available.
4. Treatment of Nose Bleeding:
   (*a*) Maintain the patient in an upright position and elevate the arms.
   (*b*) Get the patient to breathe gently through the mouth. Caution: Do not attempt to blow the nose.
5. Treatment of Foreign Substances Located in the Body:
   Do not attempt to dig out any foreign bodies, no matter how small, from any part of the body. (See below for eye injuries.)
6. Treatment of Burns, Scalds, and so forth:
   (*a*) Do not open blisters.
   (*b*) Apply burn ointment—3% bicarbonate of soda (baking soda) in vaseline.
   (*c*) Apply several thicknesses of clean gauze and bandage lightly.
7. Treatment of Acid Burns:
   (*a*) Get the patient under a shower-bath as soon as possible and thoroughly flush the parts to remove all further damage from the acid.
   (*b*) After the acid has been thoroughly washed off, dry and apply burn ointment—3% bicarbonate of soda (baking soda) in vaseline.
   (*c*) Cover wound with plenty of sterile gauze and bandage lightly.
8. Treatment of Alkaline Burns (such as from lime, plaster, potash, and ammonia):
   (*a*) Get patient under the shower-bath as soon as possible and thoroughly flush the parts to remove further damage from the alkali.

(*b*) After the alkali has been thoroughly washed off, flood the part with vinegar or milk and apply burn ointment—3% bicarbonate of soda (baking soda) in vaseline.

(*c*) Cover the wound with plenty of sterile gauze and bandage lightly.

9. Treatment of Electrical Burns:
   (*a*) Apply burn ointment—3% bicarbonate of soda (baking soda) in vaseline.
   (*b*) Cover wound with plenty of sterile gauze and bandage lightly.
10. Treatment of Unconscious Patient (any cause):
    (*a*) Lay patient on the belly with the face turned on one side.
    (*b*) Loosen all tight clothing.
    (*c*) Do not give anything to drink.
    (*d*) Call a doctor as soon as possible.
    (*e*) If breathing has stopped, proceed with artificial respiration as described under prone pressure method of resuscitation.
11. Treatment for Suffocation and Electric Shock:
    Proceed with prone pressure method for artificial respiration, adopted by the Commission on Resuscitation.
12. Resuscitation from Electric Shock:
    Proceed with prone pressure method for artificial respiration, adopted by the Commission on Resuscitation.

Much difference of opinion exists as to the value of iodine in the treatment of minor injuries. The fact of the matter is that iodine is effective or ineffective for wounds according to their nature. Iodine is an excellent antiseptic for fresh and surface abrasions. It is not so effective for deep-seated wounds because the iodine does not penetrate sufficiently. It merely causes surface coagulation and tends to close up the wound without reaching the poison.

The first-aider should be carefully chosen since he may have to meet a crisis at any moment involving human life. Captain G. R. Fisher considers that the efficient first-aider should possess observation, tact, resourcefulness, adroitness, definiteness, discrimination, perseverance, and sympathy.[1] Without such qualities he will fail in an emergency.

INFECTIONS

Absolutely the best single index of industrial surgical efficiency is the frequency and severity rate of infections to total cases. A low percentage of infections denotes good surgery on the part of the staff, thorough training of first-aiders, good plant conditions, and the cooperation of foremen and workers. Infection, or blood poisoning, results either from the entry of various kinds of bacteria at the time of injury (primary infection), or subsequently, due either to improper treatment or neglect of the wound (secondary infection).

Infections can much more easily be prevented than cured and usually without loss of time. If they do occur, treatment has to be prolonged and the time lost from work is much more than from a serious uninfected injury. Infected wounds, usually arising from a mere scratch or minute puncture, take, perhaps, four times as long to heal as non-infected cases and the average case is said to take on an average about 75 days to heal. The after-effects of infections are often serious from a production point of view. They not infrequently result in stiff joints, amputations, and sometimes death. Although there has been a great reduction in the percentage of infections in those plants where medical service has been properly organized there is still a high percentage when one considers the ease with which infections can be prevented.

It has been computed that on the average there are 836 surgical cases per thousand employees per year and, of these injuries, about 85% are infectable. The percentage of infected cases is actually much smaller and in the experience of the New York Workmen's Compensation Commission

---

[1] Fisher, G. R. "What Is First Aid to the Injured?" *The Nation's Health*, January, 1925, p. 11.

16% of all accident cases are infected. This may be considered as a general average for all plants, good and bad. In the clothing industry, for instance, the Pennsylvania Department of Labor and Industry reports 13.7% in 1921, 15.2% in 1922, and 19.0% infections to October 1, 1923. Five per cent of 84,000 wounds reported to the Compensation Board of Pennsylvania were infected cases in 1923, and, whereas there was a time loss of 14 days in non-infected cases, the average time loss in the case of infected wounds was 46 days. In England, according to the annual report of the chief inspector of factories for 1923, "in certain areas septic poisoning was far too prevalent, amounting to 7.3% of all reported accidents in one, to 8.4% in another, and to 14.2% in a third." At the forty-sixth meeting of the Conference Board of Physicians in Industry held in New York, January 16, 1925, it was shown that over 2,000 infection cases were reported among 32,500 workers during 1924, and of this number only about 20 had received treatment prior to the appearance of the infection. When such conditions as these arise there is urgent need for proper surgical first-aid.

THE CAUSE OF INFECTIONS

Bacteria are found everywhere, especially in dirt, and they are ready to enter the body through any break in the skin no matter how small. Personal uncleanliness, dirty working clothes or conditions, unclean hands or tools are generally the cause of infections when the skin is broken. These, accompanied by lack of prompt surgical attention, and of insufficient care in treatment, are quite apt to favor its occurrence. Sometimes a wound is properly treated in the first instance but is subsequently neglected, or the patient returns to work too soon, thus aggravating an otherwise trifling condition.

Most infections occur in the hands, arms, fingers, or legs. In the statistics of 11 states in 1920, 41.2% of all accidents were in the upper extremities and 28.4% were in the lower extremities, nearly all of which were infectable. In the state of Pennsylvania, during 1920, 19,884 accidents, 11.4% of the total, happened to the hands. Mock reports 588 infections, or 7.6%, out of 7,925 cases, and of these 588 cases, 95% were infections of the hand.

Truly remarkable results have been obtained in the reduction of infection in those plants where sound medical service exists. The Norton Company, of Worcester, Massachusetts, has had no infection in 2½ years. The Winchester Repeating Arms Company has had .00003% infections in 3 years and, in only 2 cases out of a total of 54,958 injuries did an employee lose any portion of the body due to infection. The iron and steel companies have also had remarkable success. The Cambria Steel Company reduced its infections in 6 years from 5.75% to .25%—.50%. Concurrent with these results has been a considerable reduction in the number of amputations which often follow infections, as shown by the following figures:

Period	Number of Workers	Amputations
1900-1905	12,000-14,000	347
1906-1910	19,000-21,000	271

A large percentage of the workers are foreign-born and understand English only with difficulty.

In the Carnegie Steel Company infected cases were reduced from 50% to .1% in three years, and out of 77,554 cases, reported by Dr. W. O'Neill Sherman in May, 1922, there were only 97 infections, or ⅛ of 1%. In the Clairton plant of the same company there were only 2 infections out of 10,000 cases. All these reductions have occurred in plants known to have adequate surgical service.

THE PREVENTION OF INFECTION

The prevention of infection consists of the training of the worker, the improvement of personal and plant hygiene, proper administration of first-aid and subsequent treatment. The worker must first be impressed with the need for strict attention to what appears to him to be nothing more than a trivial injury. In one plant there is a rule that all slight injuries shall be reported promptly to the foreman under pain of dismissal and the need for observing the rule is brought repeatedly to the attention of workers by means of lectures, bulletin-boards, and the plant periodical. Efforts are made to encourage personal cleanliness by means of health education and by providing liberal washing facilities. A study of the facts in each case of infection oftentimes suggests means of prevention. Sometimes workers fail to report promptly and at other times there is carelessness in the administration of first-aid. The use of dirty cutting oils in machine shops has already been alluded to as a possible source of blood poisoning. The best preventive, however, is prompt and adequate treatment as indicated by the following analysis recently made of 50 cases in the state of Pennsylvania:

TABLE 52

ANALYSIS OF 50 CASES OF INFECTION IN THE STATE OF PENNSYLVANIA

Hospital Facilities Available	Number of Infections	Treatment	
		Prompt	Dilatory
Plant hospital or dispensary	20		14
First-aid	27		20
No provision	2		2

These figures seem to indicate the superiority of hospital treatment over first-aid, but the figures are too small to indicate any positive relation.

FIRST-AID TRAINING

In plants containing a number of buildings scattered over a wide area or where the doctor is only occasionally in attendance some system of first-aid training will be found serviceable. The chief essentials are simplicity of treatment and adequacy of service. The training may be limited to one or two persons in each department or building so that the whole plant is covered or it may extend to successive groups so that every employee will have had some idea of first-aid. Generally speaking it is better to have a few well-trained and intelligent first-aiders than a larger number who forget what should be done in the case of emergency.

The training may be carried out by arrangement with the local Red Cross organization or by the doctor himself. It usually consists of 10 periods of 1½ hours each, based on plant experience and on the standard methods in practice.

The method should consist principally of demonstrations of what should be done in each specific case and this plan will be found more expeditious and effective than mere lecturing. At the end of the lecture course there should be an examination to test efficiency based principally on the actual treatment of cases.

MEDICAL AND SURGICAL COSTS

Little of tangible value can be positively said as to what industrial medical service will cost an employer. In the first place there is no clear distinction between medical as contrasted with surgical work. Usually surgical costs consist of hospital service, salaries, and compensation, and the cost is expressed in a percentage of the pay-roll for such expense. In addition some medical work is done by the staff in conjunction with its surgical duties and hence differentiation is difficult. Moreover, prices are increasing, medical and surgical work vary in volume, the service varies with the exigencies of the moment, and the characteristics of each industry are different.

The National Industrial Conference Board has made a series of investigations as to the cost of medical service; first in 1915 when the average was found to be $1.88, and later, in 1917 when the average cost was $2.50 per person per year. In May, 1921, another investigation was made in which 207 plants, employing 764,827 workers, expended a total of $3,387,036 on medical service, or an average of $4.43 per person. The range of cost varied from $1.84 in tobacco manufacturing to $24.40 in mining. These figures do not differentiate between medical and surgical cost and give no idea as to the cost of installation. They merely give a general idea of running costs, without even specifying what they cover.

Many of the companies included in the above report had only recently installed their medical service and therefore the cost might be expected to decrease with time, not only because health naturally tends to improve under medical care, but also because new and improved methods of work make economies possible. Moreover, the relative cost decreases as the plant increases in size, other things being equal.

The chief items, of course, are the salaries of the doctors, nurses, and attendants. The Endicott-Johnson Company, of Binghampton, spent $398,000 on its medical work in 1922, apportioned as follows:

TABLE 53

EXPENDITURES OF THE ENDICOTT-JOHNSON COMPANY ON ITS MEDICAL WORK IN 1922

Items	Cost	Percentage of Total
Salaries of doctors, nurses, attendants	$198,500	49.8
Drugs and supplies	55,000	13.8
Upkeep of automobiles and buildings	25,000	6.2
Outside nurses, doctors, hospitals, and so forth	120,000	30.2
Total	$398,500	100.

In this plant the fullest medical service is given to employees and even to their families, and the average cost amounts to over $25 per employee per year, to which the worker contributes a small amount. This figure might be considered excessively high were it not known that much inferior medical service would cost the individual employee more, and that a bonus of nearly $3,000,000 was distributed the same year, an amount seven times that spent for medical service. Viewed from this angle the medical cost is not very excessive. The cost of supplies is usually a small item for ordinary medical and surgical work. In the Endicott-Johnson Company, which supplies medicines to its 19,000 employees, the cost of drugs, including supplies, was only 13.8% of the total expenditure.

The concern of F. C. Huyck & Sons, of Albany, New York, with a full-time doctor and nurse for its 600 employees, found, according to E. H. Huyck, that, "The total cost for 11 years of the complete plan, including the cost of compensation insurance and extra pay for accidents not included under the State Compensation Law, of sick benefits, service pensions and free medicine, medical and nursing service, and hospital treatment when necessary, has been only 3.16% of the wages of the workers covered by the plan. The cost of health insurance, including medicines, medical and nursing service, hospital treatment and disability and death benefits, has been 2.21% of wages; while the cost of medical and nursing service, medicines and hospital treatment, including these services in accident cases, has been 1.04% of wages."

The Wahl plant in Chicago spent approximately $7.90 per employee in medical service, including the amount spent on workmen's compensation, the upkeep of the plant hospital, and salaries paid to employees the first week of disability. In this plant the doctor is on part-time and the plant nurse sends him any severe cases which in her opinion merit attention. The Norton Company recently estimated that it spent on its very efficient and complete medical service only three-tenths of what was spent on plant cleaning.

Compared with many other expenditures, made on behalf of the workers, medical and surgical service seems exceedingly cheap. Employers who feel that their medical expenses are high readily spend as much or more on group life insurance which cannot be compared with the value to be obtained from the former. It is much better policy to prevent sickness than to pay the relatives of dead workers.

In certain instances economy in medical expenditures has been practiced to a fault. The following statement, for instance, is made by a certain company:

> The total cost, including salaries, supplies and overhead of the upkeep of this accident room, figures out to around $2.32 a year for each of the 700 employees. The accident room has, therefore, proved an exceedingly good investment for this company.

In this company, "Over 400 medical and surgical cases a month are attended to by the nurse who is in charge; these do not include, in many instances, three or four subsequent visits for redressings."

This "exceedingly good investment for the company" is not so good for the nurse whose salary must come out of the $1,624 spent. The average weekly salary for female dispensary nurses is about $30 a week; yet, in this case, "the nurse finds time to call on the sick person during the evening." A significant fact is that while redressings are freely given there is no mention of the services of a medical man, a proceeding illegal if not dangerous.

Dr. W. Irving Clark made a tabulation of medical costs for industries of various sizes; it is given in Table 54, on the following page.

The figures in this table provide for an expenditure of about $6 per employee per year on medical service which will generally be found adequate for ordinary needs.

The American Management Association, through its Committee on Health Supervision in Industry, ascertained the following facts for 1923: "Health supervision in plants

TABLE 54

ESTIMATE OF EXPENSES OF MEDICAL PERSONNEL, AND SO FORTH, 1921[1]

Particulars	Number of Employees				
		500		3,000	
Number of full-time doctors	0	0			
Number of part-time doctors.	1	1			3
Cost of doctors...... . ..	$360	$540	$1,200	$5,400	$10,000
Number of full-time nurses...	0	0	1	3	6
Cost of nurses.	0	0	$1,560	$4,680	$9,360
Number of dispensaries .	1	1	1	3	5
Initial cost of equipment..	$250	$500	$1,000	$2,000	$4,000
Cost of supplies, per year....	$240	$700	$1,200	$3,600	$6,000
Total medical cost per year..	$1,200	$3,000	$6,000	$18,000	$30,000

specifying cost items, was conducted at an annual rate of $6.89 per employee. Direct costs were $5.81 per employee, salary expenses amounted to $4.21, and direct maintenance to $1.98. Indirect charges, such as rent, light, and other indirect items, amounted to 57 cents per employee per year."

---

[1] Clark, W. Irving. *Health Service in Industry.* The Macmillan Company, New York, 1922.

XV

ACCIDENT PREVENTION

Extent; general and industrial. Causes of accident. The human element. Accidents and new employees. The location, extent, and nature of injuries. Prevention. Safety organization. Safeguarding. Education. Inspection. Records and reports. Frequency and severity. Results obtained.

LABOR has certain wants, some of which, whether legitimate or not, ought to be satisfied since the employer will find, often to his surprise, that their satisfaction is both humane and economical. Among the insistent demands of labor is that of continuity of employment. This the employer cannot always give, for there are times when no orders come in and he has to shut down the plant. But when the plant is running, the worker likes to feel that he can keep on the job. Formerly if the place was unsafe and accidents occurred, the worker lost his pay, he suffered sometimes from a grave mental and physical shock and had to pay his medical expenses as well. The workmen's compensation acts have somewhat modified the cruelties and crudities of the old system, but, at the very best, compensation is nothing as compared with accident prevention.

Accident prevention is a good thing for all concerned. It saves the employer loss of time and service and reduces the cost of compensation. It conserves the life and substance of the worker, relieves him from suffering, and makes it possible for employer and employee to work in amity.

Though there has been a great net reduction in accidents in the last decade, but little improvement can be seen in the last year or two and the aggregate number at the present time is enormous. Carl Hookstadt, in the *Monthly Labor*

Review for November, 1923, calculated the number of accidents at 2,474,650, which caused the loss of 350,000,000 working days and a billion and a half in wages. In the 10 principal manufacturing states in 1921, 9,349 persons were killed in industry and there were 1,382,871 non-fatal accidents as well.

The following figures have been compiled by the various industrial sections of the National Safety Council to show

TABLE 55

ACCIDENT STATISTICS, BY INDUSTRY [1]

Nature of industry	Paper and Pulp	Petroleum
Period covered	1923	1923
Average number of employees	44,089	50,058
Number of hours worked	115,901,680	131,090,233
Deaths	29	32
Permanent disabilities	91	70
Temporary disabilities	4,922	4,340
Total accidents	5,042	4,442
Days lost, total	316,419	335,163
Deaths	174,000	192,000
Permanent disabilities	70,084	54,144
Temporary disabilities	71,435	89,019
Accident frequency rate	43.50	34.14
Accident severity rate	2 730	2.576

Nature of industry	Woodworking	Rubber
Period covered	1923	1923 (6 months)
Average number of employees	24,144	
Number of hours worked	58,822,216	
Deaths	15	15
Permanent disabilities	100	26
Temporary disabilities	2,371	
Total accidents	2,486	
Total days lost	197,508	79,593
Deaths	90,000	
Permanent disabilities	73,626	
Temporary disabilities	33,882	
Accident frequency rate	42.26	26.73
Accident severity rate	3.357	1.15

Nature of industry	Automotive	Metal
Number of companies represented	22	68
Average number of employees	120,000	60,000
Hours worked	294,388,104	168,348,053
Accident frequency rate	20.29	46.85
Accident severity rate	0.967	1.634

---

[1] *National Safety News,* July and September, 1924.

the number of accidents, their frequency and severity rate, and the time lost in comparison with time worked.

The figures in Table 55 constitute a very interesting accident record from which it is discovered that, for every million hours worked there are on the average 30 lost-time accidents (the frequency rate) and that the number of days lost per thousand hours worked (the severity rate) may vary from slightly less than one, to over three days. It will also be seen that though the accident rate varies, the time lost is no inconsiderable portion of the total working time.

THE CAUSE OF ACCIDENTS

In seeking the prevention of accidents the first step is to ascertain the cause, on the theory that what has happened once may occur again. Statistics from the Bureau of Workmen's Compensation of the Pennsylvania State Department of Labor and Industry for January to July, 1924, inclusive, give the facts listed in Table 56.

The principal causes of accidents, classified into groups, are as follows:

1. Machinery
2. Vehicles
3. Explosives, electricity, fire, heat, corrosives
4. Poisons, corrosives, occupational diseases
5. Falls of persons
6. Stepping on or striking against objects
7. Falling objects, not being handled by injured
8. Hand tools, flying nails, chips or particles
9. Animals
10. Miscellaneous

In an investigation of the causes of 300,000 accidents, made by the National Bureau of Casualty Underwriters, it was ascertained that accidents most frequently occurred at the "point of operation;" that is to say, accidents are essentially the result of motion and, therefore, their causes must be sought for in those operations where motion is intense. Hence, we find that in the handling of objects and in work-

TABLE 56

CAUSES OF FATAL AND NON-FATAL INJURIES IN PENNSYLVANIA FROM JANUARY TO JULY, 1924

Cause of Accident	Number of Injuries Fatal	Non-Fatal
Machinery	47	9,911
Boilers	5	116
Pumps, compressors, prime movers	2	312
Transmission	11	219
Elevators	31	456
Cranes and derricks	42	1,954
Cars and engines	266	12,112
Motor vehicles	67	3,513
Horse vehicles	15	1,107
Hand trucks	9	2,611
Water craft	7	81
Handling objects	38	21,388
Hand tools	15	10,258
Electricity	33	655
Explosives and explosions	148	1,052
Hot and corrosive substances	54	3,837
Falling objects	65	4,837
Falling objects (mines and quarries)	255	8,161
Fall of persons	104	10,549
Stepping upon or striking against objects	14	6,151
Miscellaneous causes	11	3,850
Total	1,294	103,193

ing machinery are to be found the principal sources of accidents. In Wisconsin, during 1919, out of 14,000 accidents 42.7% were due to these two causes alone. Falls of person, moving vehicles, cars and engines, falling objects, and stepping on or striking objects were responsible in the aggregate for 5,451 accidents, or 36.3% of the total. Together, all these constitute 79.0% of all accidents occurring in one year in Wisconsin.

We have, also, to reckon with the human element and those factors in the human element which bring accidents to some, and leave others scatheless. Age, for instance, affects the frequency and severity of injuries. As people get older the rate is found to decrease. Youth is unskilled and careless, and older persons are found in the skilled trades. Nationality, in itself, has no influence on the accident rate. Nevertheless, on account of the fact that foreign-born workers often fail to understand directions of printed warnings, they are more subject to accidents than English speakers. The recently arrived immigrant is generally engaged in the heavy and hazardous occupation. Whereas English speakers lose 22.4 days, non-English speakers lose 29.5 days per 300-day workers in certain trades. In the experience of the Ohio Industrial Commission 50% of the fatal accidents happen to foreigners. At a round-table discussion which took place at the annual National Safety Congress in October, 1924, it was shown that the Near-Eastern foreigners had the greatest number of lost-time accidents.

THE HUMAN ELEMENT AND ACCIDENTS

The length of employment has an important bearing on the accident rate; how important, each plant must determine for itself. As experience increases, the likelihood of accidents diminishes and, therefore, a high labor turnover is liable to be accompanied by a high accident rate.

The figures given in Table 57, below, illustrate the point. These figures show, in this particular instance, that

TABLE 57

AVERAGE NUMBER OF EMPLOYEES IN THE METAL TRADES INJURED PER DAY AFTER BEGINNING WORK, BY SEX [1]

Length of Employment	Male	Female	Total
First day	166	294	460
Second day to end of first week	38	45	83
Second week to end of first month	11	6	17
Second month to end of sixth month	3	1	4
Seventh month to end of first year	1	.5	1.5

---

[1] "Cause and Prevention of Accidents in the Iron and Steel Industry," *Bulletin Number 298, Bureau of Labor Statistics,* Washington, D. C., p. 171.

81.4% of the accidents occurred on the first day of employment and that over 96% of all the accidents happened within the first week of employment! The above figures are an apt illustration of the value of statistics in accident prevention. They demonstrate, beyond question, the vital need in certain occupations for instructing and supervising the new worker. "Teaching Safety to New Employees," *Safe Practices Pamphlet Number 65,* published by the National Safety Council, may be used to advantage for this purpose.

There is a definite relation between accident and time. More accidents are apt to occur at night than in the day, principally because the light is bad, but also because the worker himself is not apt to be in as good mental or physical condition and there is less supervision than in the daytime. Were it not for the fact that there is less congestion, less speed in work, and that there are more experienced workers it is probable that the night accident rate would be much higher than is generally the case.

Comparing the accident rate of one day in the week with another there seems to be a gradual increase in the accident rate as the end of the week approaches, with the maximum rate on Friday. In 34,806 accidents, 13.5% occurred on Monday, which gradually increased to 18.2%, the maximum, on Friday.

A similar phenomenon is found in an analysis of the time of day in which accidents occur. Comparing the first working period with the last, the rate is generally greater in the early portion of the day but, in both, the accident rate increases as the time for ceasing work approaches until the last hour of work when accidents decrease. When work begins at 7 a.m. with a five-hour working period, the accident rate is at its maximum between 10:00 and 11:00, and where there is a four-hour period in the afternoon, beginning at 1 o'clock after an hour's interval, the accident rate reaches its maximum between 3:00 and 4:00.

THE LOCATION OF INJURIES

As might be expected, those parts of the body most used at work are most liable to injury. In certain industries eyes are peculiarly exposed, as in grinding and chipping; in other industries workers suffer many injuries to the feet and toes from falling pieces of metal, as in carrying pig-iron, but usually the hand, and that part of it which is most used, has the highest rate.

These facts are illustrated by a study of over 5,000 injuries in the iron and steel industry causing permanent disability.

TABLE 58

LOCATION OF INJURIES CAUSING PERMANENT DISABILITY IN THE IRON AND STEEL INDUSTRY, 1910 TO 1914 [1]

Location of Injury		Number of Injuries	Total	Percentage
Upper Extremities:				
Arms		69	.	...
Hands		101		....
Thumb	415		....	....
First finger	1,910		...	....
Second finger	230		..	...
Third finger	173		.	....
Fourth finger	193	2,921	3,091	60.9
Lower Extremities:				
Leg		108	....	....
Foot		132	...	....
Toes		416	656	12.0
Eye		...	489	9.6
Other		....	844	16.6

Of the total injuries sustained over 60% were in the upper extremities, and only 12% in the lower extremities. Of all those occurring to the fingers and thumb no less than 65.4% were on the first finger.

In order to secure facts as to the question of vulnerability and also to find out what surgical equipment is necessary for their treatment it is advantageous to classify injuries according to some definite procedure. The following may be suggestive:

---

[1] *Bulletin Number 234, Bureau of Labor Statistics,* p. 274, July, 1918.

Asphyxia
Electric flash
Crushing injury
Heat exhaustion
Electric shock
Loss of teeth
Frostbite
Accidental dismemberment
Abrasion with infection
Cut with infection
Laceration with infection
Burn with infection
Scald with infection
Fracture with infection

Abrasion
Bruise
Cut
Laceration
Puncture
Burn
Scald
Concussion
Dislocation
Fracture
Sprain or strain
Nervous shock
Hernia

In the blast furnace departments of the iron and steel industry between 1905 and 1914, the following injuries were found:

TABLE 59

ACCIDENT FREQUENCY RATE, BY NATURE OF INJURY, 1905-1914 BLAST FURNACES; 13,849 300-DAY WORKERS[1]

Nature of Injury	Frequency Rate, per Thousand
Asphyxia	6.6
Bruises, cuts and lacerations	89.2
Burns	50.0
Crushing injuries	3.3
Dislocations and sprains	11.5
Electric shock	.1
Eye injuries	18.8
Fractures	10.9
Heat exhaustion	.1
Infections	9.1
Unclassified	5.7

The Wisconsin Industrial Commission has issued an interesting tabulation of the number of injuries by nature and location of injury and extent of disability during 1923 in its *Wisconsin Labor Statistics* for June, 1924.

---

[1] *Bulletin Number 234, Bureau of Labor Statistics,* June, 1918, p. 185.

ACCIDENT PREVENTION

Fixing responsibility is one of the first considerations in any scheme for prevention. The employer has little hesitation in claiming that the worker is generally responsible, while the worker is equally ready to blame the employer. In addition to possible negligence on one side or the other there is a "trade risk" inherent in every industry for which neither can be held responsible.

The employer is, however, sometimes negligent in providing guards on running machinery, or the proper kind of appliances, or in failing to instruct men as to possible dangers and in not providing the proper place, space or conditions of work, an instance of which is insufficient lighting.

The worker, even when properly instructed, sometimes neglects to use the safety devices which are provided. He violates safety rules, does work in unsafe ways, or is merely careless. He is also a victim of the carelessness of fellow workers who, in their turn, fail to take the necessary precautions. Even the rate at which work is done may affect the accident rate adversely or otherwise. In some cases the employer unduly speeds up the worker; in others the worker, being on piece-rate, takes chances in order to increase output. It is difficult, therefore, to apportion responsibility, and only the most general approximation of blame can be assigned. In some industries the "trade risk" is high and to it may be traced perhaps half of the accidents that occur. The negligence of the employer, in failing to provide guarded machinery, and a safe place to work accounts for 20% of the accidents, while the carelessness of the worker is accountable for three-tenths of the whole.

It is generally conceded that carelessness on the part of the worker is responsible for a considerable proportion of all accidents. According to one authority, mechanical guards would have prevented but a small proportion. In railroading, it is said that only 7% of accidents in that industry arise from defective machinery; no information, however, is added as to how many accidents occur in cases where the machinery is not defective. A mutual casualty insurance company claims that 92% of all accidents result from carelessness, which must be comforting to the employer since it shifts the responsibility. The relative proportion of hand to mechanical work affects the situation. Some machines, doing much work, are quite safe, while others are dangerous though infrequently used.

> A study of the causes of 220,707 accidents, which have occurred in the plants of the United States Steel Corporation, shows that but 4.94% of the total number, except those in connection with overhead electric cranes, were due to machinery causes. Hand labor caused 44.42% . . . the majority of which cannot be controlled by the use of safety devices and appliances. The conditions under which these accidents occur are under the control of the workers and are largely due to their carelessness or thoughtlessness . . . at least 90% of the accidents might have been prevented if a little more care had been exercised.[1]

In a report of the Accident Prevention Committee of the National Electric Light Association in June, 1921, an attempt was made to apportion responsibility for accidents and the following summary represents the opinion of 17 companies:

Percentage of Accidents Due to:

(*a*) Negligence of foreman (or chief)	6.24
(*b*) Negligence of workmen	84.75
(*c*) Defective devices	9.13

With such facts in mind the plant must be thoroughly organized for safety.

THE SAFETY ORGANIZATION

Thorough organization is necessary to prevent accidents, in which the active support of the management is of the first importance. The manager's belief in safety must be both positive and active and he must provide a specific place for safety in the plant organization. Moreover, his department heads will need to be persuaded that he means business and they, in their turn, must bring conviction to their foremen and through them to each worker. A plan which overlooks any class of employee is faulty.

---

[1] *Bulletin Number 8* of the Bureau of Safety, Sanitation and Welfare, United States Steel Corporation.

Some managers do not understand the economic value of safety. Their interest has not been aroused and, as a consequence, no statistics can be produced to show how production is hindered by accidents. No very extensive inquiry is needed nowadays to show that accident prevention more than justifies itself, and results have been secured in many industries which are sufficient to persuade even the most skeptical.

A manager, seriously desirous for safety, can begin by explicitly stating his intention to make his plant a safe place to work. The proof of his good faith will be seen in his efforts to remove structural and mechanical hazards. Having taken such steps it will be easy to secure the cooperation of the workers. At this juncture it is advisable to have a general meeting of the workers where the plant manager can explain his plans, tell what he has done, what he expects to do, and how he intends to do it. Cooperation is easily secured in this way.

In preparing a safety plan due consideration should be given to the nature of the industry, the hazards involved, and the relative value of different methods in use for securing results.

The foundation of any plan consists of a thorough study of past accident experience. Every previous accident may occur again unless steps are taken to prevent it. Hence, a full study is indicative of what should be done.. The workmen's compensation commissions in the different states insist on full accident reports and these constitute the basis for an adequate statistical analysis.

Any scheme for accident prevention consists of three phases: organization of the employees; mechanical and structural safeguarding; and education of the worker in safety methods and practices. R. J. Young, of the Illinois Steel Company, has proposed the following very suggestive summary of the relative value of the different phases of prevention:

TABLE 60

RELATIVE VALUE OF DIFFERENT PHASES OF PREVENTION

Particulars	Relative Value	Totals
Organization:		
Attitude of officers	20%	
Safety committees	20	
Inspection (workmen)	5	45%
Safeguarding:		
Safety devices	17	
Lighting	5	
Cleanliness (housekeeping)	3	25
Education:		
Instruction of men	15	
Prizes	9	
Posting signs	3	
Lectures	3	30

This summary provides an excellent basis for action, to be modified or intensified according to circumstances. Safeguarding and mechanical revision, for instance, tend to reduce serious and fatal accidents; supervision tends to control serious and minor accidents; and education may be relied on to reduce minor injuries.

In establishing the plant safety organization steps must be taken to cover the whole ground by means of the safety engineer with the cooperation of the workers so as to be sure that the machinery is safe and the worker himself is careful.

In plants employing over 1,000 workers the full-time services of a safety engineer will be required, depending, however, on the rate of accidents and the character of the operations. Plants with high accident rates, spread over wide areas, demand more attention than those doing repetitive work of a light nature and occupying three or four floors of one building.

The duties of a safety engineer are both direct and indirect. He investigates all accidents and conditions surrounding them as soon as possible after occurrence and compiles the necessary reports pertaining thereto. He institutes measures to prevent recurrence from personal observation of the facts. It is his duty to provide for the erection of safe machinery, for the construction of guards, and for the maintenance of safe conditions. He plans the safety committee structure of the plant, arranges for meetings and acts as secretary, delivering safety talks, discussing accidents, and distributing literature. He has charge of the maintenance of the bulletin-board literature and of all matters relating to accident insurance.

The safety engineer is responsible for the creation and management of safety committees, of which there are sufficient kinds and numbers to cover the plant thoroughly. The general safety committee, consisting of representatives from the principal departments, looks after safety matters of general interest, makes general periodic inspections of the plant, and supports the safety engineer in carrying out preventive measures applicable to the plant as a whole. In addition, there are departmental safety committees which inspect their own departments monthly and are generally responsible for seeing that the workers observe the rules and regulations, that they generally follow safe practices and use the guards provided for their protection. There may be, also, special committees consisting of men who are experts in special phases of the problem. These committees are usually established to assist the general committee in the investigation of special conditions by the study and reporting of facts.

Departmental committees are responsible for the training of workers in cooperation with the safety engineer, and for seeing that their fellow-workers follow the established safe methods. The latter is accomplished by periodic departmental inspections. A special inspection is made by the committee in case of accidents. Membership on such committees is rotated so that, in time, the larger percentage of workers will have had some committee training and a certain amount of responsibility for prevention placed on their shoulders.

The Scovill Manufacturing Company, of Waterbury, Connecticut, with 3,500 employees, has a permanent safety advisory committee, composed of foremen and superintendents, which is largely responsible for the prevention of accidents. This committee makes frequent inspections of hazardous work and investigates serious accidents. It advises as to safety measures and devices to be adopted in new buildings and inspects the scene of accidents.[1]

The safety man's work includes engineering activities. The failure of the employer to consider safety as a necessary feature in the design of new buildings, in the erection of machinery, or in supervising their operation when in place, must be corrected. In spite of the great safety movement of the past few years it is still quite common to have whole plants designed, erected, and operated without one single reference to the question of safe operation, as far as the human element is concerned. The following rule is, therefore, of the utmost importance in the cause of safety:

> No building, machine or appliance shall be erected or installed unless provision is made for safe occupancy and use, according to approved practice.

This rule should be followed in the construction or engineering department of every large organization in the country. Had it been followed, even for the last 10 years, a vast number of accidents would have been prevented and much subsequent expenditure on safety would have been avoided. Many plants have been erected long before systematic accident prevention became usual and they still remain monuments of what not to do in accident prevention. What the safety engineer has to do, under such circumstances, is to adapt the buildings and machinery to modern safety requirements. This has now come to be known as "engineering revision," a term invented by Dr. Lucien Chaney to denote "the widest application of engineering skill to the safety of industrial plants."

---

[1] "A Good Industrial Health Organization," *The Nation's Health*, September, 1924, p. 623.

Dr. Chaney discovered that many of the major accidents that occur, particularly in the iron and steel industry, are due not to the carelessness of the worker but to the failure of the engineer and the constructor to consider safety of the workers when designing plant and machinery. Hence, we find many ordinary occupations carried on under unsafe conditions which could have been avoided in the construction of the plant, and often without any additional cost whatsoever. A narrow door is a hand and knuckle hazard in a metal smelting plant; adding a foot to the width of the door would have cost less and would have made it safe for use.

Engineering revision embraces the redesigning and location of buildings with special reference to safe operation: wider exits, greater clearances, railed platforms, and easily accessible points for oiling, repairs, and the like. It seeks to provide ready and safe access to every place where the worker has to go and ensures adequate and properly arranged artificial lighting. It aims to provide for the design and operation of machines from a safety standpoint and the replacement or modification of those that have proved to be unsafe, even when efficient in manufacturing. The revising engineer encloses electric switching, provides directly connected motors, cares for the guarding of cranes and conveyers, and sees that all manufacturing operations are considered from the point of view of safe operation.

In engineering revision there is now happily a vast store of information not formerly available. The National Safety Council and other engineering organizations have established standards and codes with due regard to safe operation. The National Safety Council has issued, in the last few years, a comprehensive service of "Safe Practices Pamphlets" which cover almost every phase of engineering revision so that a person designing a plant or machine from the view-point of safety has only to refer to them in order to ascertain those methods which have proved effective. Pamphlets have been issued on the following subjects:

Safe Practices Pamphlets Issued by the National Safety Council

1. Ladders
2. Stairs
3. Boiler Rooms
4. Cranes
5. Belt Shifters
6. Knots, Bends
7. Belt Guards
8. Shafting, Chains
9. Engines
10. Oiling Devices
11. Floors
12. Scaffolds
13. Grinding Wheels
14. Goggles
15. Freight Elevators
16. Clothing
17. Yards
18. Power Presses
19. Exits, Alarms
20. Woodworking
21. Records
22. Lighting
23. Welding
24. Fire Extinguishers
25. Acids and Caustics
26. Wire Ropes
27. Toilet Facilities
28. Explosives
29. Electrical
30. Trucks
31. Fire Causes
32. Exhaust Systems
33. Hoisting
34. Explosives
35. Conveyers
36. Fire Brigades
37. Ventilation
38. Bulletins
39. Machinery
40. Suggestions
41. Hand Tools
42. Organization
43. Elevators
44. Cutting Oils
45. Housekeeping
46. Fuel-Handling
47. Compressed Air
48. Railroads
49. Boilers
50. Fatigue
51. Campaigns
52. Electricity
53. Plans
54. Handling Material
55. Handling Material, II
56. Investigations
57. Health Service
58. Guard Construction
59. Warehouse and Shipping
60. Chemical Laboratories
61. Refrigeration
62. Motion Pictures
63. Oil Storage Tanks
64. Respirators and Gas Masks
65. Safety for New Employees

The need for authoritative safety codes has been so widely felt that various organizations, acting independently, have aimed to establish their own standards. Quite recently a Safety Code Correlating Committee has been formed to act as an advisory body to the American Engineering Standards Committee. This organization invites the cooperation of representatives of equipment manufacturers, employers, employees, government representatives, technical experts, and insurance men. This representative body, in conjunction with various interested parties, is now engaged in the establishment of safety codes for various needs and they may be considered as representing the best existing practice.

ACCIDENT INSPECTION

Systematic inspection forms an important feature in the prevention of accidents. There is, first, the skilled inspection by the trained man—the safety engineer—who, with a thorough knowledge of the possible causes of accidents, is enabled to discern unsafe conditions at a glance. This inspection must be periodic, unexpected, and thorough. It is concerned with the use of machinery guards, the elimination of unusual hazards, the maintenance of cleanliness and orderliness, and the use of safe practices.

In the larger plants, those with 1,500 to 3,000 employees, a safety inspector relieves the safety engineer of routine work and makes periodic tours of every part of the plant along a prescribed route for the purpose of inspecting cranes, hooks, ladders, chains, elevators, machines, and appliances. He refills the bulletin-board with fresh literature, superintends the installation of safeguards, compiles weekly reports of his inspections, and makes weekly accident statistical reports.

The following plan of inspection is suggested in a bulletin issued by the National Safety Council:

> 1. Follow the oiler; he must oil the bearings. Can he reach each bearing safely? Is his route a safe one?
>
> 2. Can an accident occur here?—not, has an accident occurred here?
>
> 3. Inspect out-of-the-way places; many men are injured where, "nobody ever goes."
>
> 4. Conditions in yards, roadways, and passageways are always changing. Inspect for dangerous piles, defective floors, protruding nails.
>
> 5. Weak links in chains, broken strands of wire, chains and cables should receive special attention.

6. Guards should be in place, particularly adjustable guards.
7. Look for dangerous practices. Many accidents are due to carelessness, recklessness, and ignorance.
8. Four big causes of accidents are: men falling from high places; objects falling on men; men dropping things; handling tools.
9. Watch for torn or loose clothing.
10. Look for cuts, scratches, bruises, and find the cause.

As a result of such inspection there should be a report of the existence of any unsafe conditions found and a follow-up to see that correction is made.

SAFETY EDUCATION

Great strides have been made by employers in effecting the mechanical safety of their plants. But, as has already been indicated, by far the larger proportion of accidents are due to what we call "carelessness," perhaps as much as 70%. The time has arrived, therefore, for intensive education of the worker to eliminate carelessness and to acquire the "habit of safety."

The basis of successful safety education, as of successful accident prevention in the mechanical sense, is a knowledge of the facts so that the objective may be as specific as possible. Education should be concentrated on that portion of the personnel which shows itself most subject to accident, and the organization that has been created to eliminate mechanical hazards can also be adapted to the requirements of safety education.

Boyd Fisher has pointed out, recently,[1] that the mental causes of accidents are due to ignorance, predisposition, inattention, preoccupation, and depression, of which the most prolific cause is ignorance. It may be noted, too, that the very factors which cause accidents are those which operate against efficient production.

---

[1] Fisher, Boyd. *Mental Causes of Accident.*

The purpose of safety education is to dispel ignorance by any available means. The safety engineer who sees nothing but a mechanical side to his job cannot be a success. He must be a teacher as well. Assisted by competent committees, meeting regularly, the safety engineer is enabled in inculcate the idea of safety more as a human than a mechanical problem, and this teaching must be brought right down the line even to the most insignificant worker.

The individual may be reached in a variety of ways; occasionally by general, departmental, or sectional meetings, but particularly through the agency of workmen's committees which have been found to be most effective, since every one is reached through rotation. Workmen react very favorably to placement on committees; they are in many cases the only positions of standing a workman is likely to reach. Membership makes them vigilant of their own acts and of those of others so that eventually education permeates into every corner of the plant.

The South London Metropolitan Gas Company has had an accident jury at work for the last 30 years. When a lost-time accident occurs, 12 employees are summoned to consider the case and to fix the blame after the evidence has been heard. Most of these men are not employed in the department where the accident occurred and they are therefore likely to be dispassionate in their findings. The workers serve on the jury by rotation.

After the scene of the accident and the attending circumstances have been reviewed the jury is asked the following questions:

1. Was the injury caused by accident arising in the course of the injured member's employment?
2. Was the accident caused by any defect in the plant or materials used, and if so, what was it?
3. Was there any mistake in the manner in which the work was done?
4. Was the accident due to carelessness of the injured person or negligence on the part of any officer or foreman?

5. Was the accident due to carelessness of the injured person or any fellow workman?
6. Was the accident attributable to the serious and wilful misconduct of the injured member, or any other person?
7. Was it a pure accident for which no one is directly to blame?
8. Can anything be done to prevent similar accidents?

The importance of this plan, apart from that of fixing responsibility, lies in its educative features.

The method of education to be adopted must suit the character of the personnel. If the workers are highly skilled and American-born an appeal can be made through their mental faculties. If the labor force is composed of a large percentage of foreign-born workers it is obvious they will have to be approached through the visual faculty or by means of the slower process of language instruction wherein safety education is a part. The safety engineer has two methods of approach to the former: the direct and indirect. Guided by a knowledge of the causes he should arrange a series of talks on the general problem as well as on specific cases. Such talks may be frequent, either to the employees as a whole or in groups. In addition a few simple safety rules may be issued for the guidance rather than the compulsion of the worker, but the purpose of every rule should be clearly explained.

The plant publication is freely used to disseminate ideas of safety, to publish accident statistics, and to create a spirit of competition between departments. Efforts must be made to procure and disseminate safety literature either to the worker individually or by placing letters, messages, admonitions, or encouraging words on safety bulletin-boards. Such literature is available at slight cost from organizations like the National Safety Council.

The difficulty of reaching the non-English speaker through literature exists, but it is apt to be exaggerated. If he does not understand the safety message handed to him he takes it home, if he is married, to his English-speaking wife, brother, or child who translates it. Thus safety is brought into the home circle as well.

Since education is to be undertaken it is desirable to size up the trainable qualities of the plant personnel. If the employment department has been duly impressed with the importance of safety in the selection of workers it will have chosen those who seem to be intelligent enough to avoid accident. Moreover the time to begin training is when the worker steps into the plant for the first time. In the employment office may be seen safety signs, and part of the process of hiring is that the worker makes himself acquainted with the safety requirements of the plant as set forth in the "Employee's Handbook" which is handed to him when he is hired.

Emphatic evidence has been submitted to show that the first day of employment is the most dangerous. Therefore, if the foreman has any regard for safety he will take particular pains to instruct the new man specifically as to hazards of his job and see that he acts according to instructions.

Of visual methods of instruction there is now quite a considerable variety. Such methods are specially suitable for workers who cannot read or understand English. The simplest form is the picture or photograph of unsafe practices which is placed on the bulletin-board and frequently changed. Some plants have moving pictures dealing with safety and the necessary hall and equipment for their display; others procure some from the available stock as opportunity offers. These may be shown to a portion of the force at a time till every one in the plant has had an opportunity of seeing them. It is advisable to sandwich safety with some lighter features. The National Cash Register Company, for instance, displays safety pictures the first day of employment.[1] Another form of visual training is the display of exhibits or object lessons; the torn shirt, the fractured goggles, the burred tools, and so forth. In some plants a safety float makes a tour through the plant with an exhibit of hazards or safety for all to see.

---

[1] See "Motion Pictures in Educational Work," *Safe Practice Pamphlet, Number 62,* National Safety Council, Chicago, Illinois.

Bilingual signs and slogans have their use particularly if displayed judiciously. A prominent safety sign, hung over the main entrance, serves to remind the worker of the subject, each morning as he enters, and the same sign is illuminated at night for the oncoming shift. These signs are placed where they will be most frequently seen; in the main thoroughfare; at the entrance to the lunch room, or in the entrance to the main working rooms. The language on the sign should be in accordance with the nationality of the worker; some of them know how to read and they will tell others what it is all about. It is well to remember that hardly a third of the foreign-born are literate in their own language, and such people hear from the literates what is going on.

Signs, to be effective, must be well printed and kept fresh and bright. If they are dingy and neglected in appearance the natural assumption is that the subject of safety is in the same category.

In specifically unsafe conditions men must be specially instructed as to the precautions to be taken to avoid injury as, for instance, in the use of goggles, the congress shoe in working with hot metal, and certain machine guards. A guard, the operation of which is unfamiliar, is a hazard in itself. The worker, unaccustomed to the speed of shafting, needs to be trained as to the danger of flowing neckties, loose sleeves, or coats, and he may be merely told that these are unsafe but he will not be impressed unless the danger is demonstrated. Demonstration is an invaluable phase in the education of workmen.

It is a common error to take up safety education with enthusiasm for a brief spell and then let the interest flag. The subject must be kept constantly renewed in novel form to maintain interest. There may be interdepartmental contests, safety campaigns, special drives against unsafe ladders, crane accidents, or eye injuries. The interdepartmental contest is arranged for a special period and the accident rate is worked out on a man-hour basis. Interest is maintained by an adjustable score board, placed conspicuously, which shows the relative position of each department in the contest from day to day till the end of the period. Prizes are distributed to the department with the lowest score. These consist of safety buttons of different colors, or the "safety banner" to be displayed in the successful department until the next contest.

A safety campaign is a more or less elaborate affair conducted either for the purpose of introducing safety or to stimulate a lagging interest as evident by an increasing accident rate. The first move, in the case of a beginning, is to analyze the accident record, the personnel, the plant, and the working conditions from a safety aspect. Then the plan of procedure is mapped out; there is first an appropriation after approval; the reasons for making the campaign are explained to the employees, the general objective is pointed out, the duration and date of the event are fixed, and the expenses distributed. The participation of each class of employee is arranged for, the activities are selected and organized, meetings are held, and competitions are prepared for. The whole campaign is preceded by a well-arranged publicity which is maintained throughout the period of the contest; safety suggestions are sought from employees, prizes are offered for the best suggestion, and the campaign concludes with a declaration of the results and the awarding of prizes in the form of cash, medals, magazine subscriptions, or books.

A two-week safety drive of the Gilbert and Barker Manufacturing Company was found to be a powerful stimulant in prevention and resulted in the replacing and repairing of defective machines and tools, and no less than 153 safety recommendations were made by the employees. Success in the safety drive was due to strict adherence to the rules given on the following page.

1. Educate the employees thoroughly in the work through constant personal contact and demonstrations of actual results from improper acts.
2. Do not waste time and money on safety drives and other expensive publicity until the employees are fully conversant with what you are intending to do and show a willingness to cooperate.
3. Get down to brass tacks on each subject and stay there until it is properly rounded out.
4. Make each endeavor count from its own weight; that is, make one injury prevent another, both to the injured and others. Build guards so they will be attractive, effective, and in no way an obstruction to millwrights, belt-men, or machine operators.
5. Do not hurry, worry, or get angry. Make each employee feel you are a real fellow; one whom they can tell their troubles to and receive help from. Treat all confidences seriously and sympathetically, when necessary.
6. Keep the management perfectly informed concerning the progress of the work.
7. Wherever possible order machines already provided with guards.
8. Build guards as part of the machine. Never neglect to get the machine operator to tell you how he thinks the guard should be built.[1]

The bulletin-board and bulletins have been mentioned as an educative means; they are far from being unimportant. The board is glass-covered and locked and it is used as a means of giving information, creating competition, and stimulating interest in safety. The boards should be placed prominently; interesting material should be provided and changed frequently. Near drinking fountains, in locker rooms, at the time clock, in each room or department, or wherever workers assemble are suitable positions. The bulletins should be brief, newsy, and in simple language. Pictures are always attractive and may be used to advantage. The National Safety Council has issued many hundreds of safety pictures, cartoons, and instructions which are constantly being added to. It is specially necessary that some one should be responsible for the procuring, placing, and replacing of literature. If the supply is insufficient the material may be displayed in departments by rotation.

---

[1] Babcock, K. P. "Do Safety Drives Pay?" *National Safety News*, September, 1921, p. 32.

Workers object to being lectured like a lot of school boys. They do not mind informal talks. In starting a talk the first problem is to fix attention either by telling a good story or by making a startling statement, relating to the subject. Then the hazards of different occupations may be shown, together with the means of avoiding them by various safe practices, using, as illustrations, such accidents as have recently occurred and, finally, the suffering which such accidents bring. If the cause of accidents can be demonstrated, so much the better. Slides and films may also be used to advantage. What impresses persons most is, of course, the losses they suffer, and this phase of the subject should be clearly brought out.

Talks may be given at the lunch hour successively in various departments or to the whole group of workers at one time, as circumstances permit. When the lunch period lasts an hour there is ample time. The attendance is not so good if the lecture takes place in the evening unless there are other attractions sandwiched in. In this case a hall should be selected somewhere in the vicinity of the plant near where most of the employees live. Lectures should not last more than 20 or 25 minutes and every word should be prepared beforehand unless the lecturer has a special experience and capability in addressing groups.

ACCIDENT RECORDS AND REPORTS

The importance of properly prepared accident records, founded on reports, is that they clearly show how, when, and where accidents happen and thus make prevention possible. An accident report should contain all information necessary not only to fulfil the requirements of the workmen's compensation acts but also to provide the data needed for a sound preventive policy.

The following is a summary of the essential facts needed:

(*a*) Facts as to injured person
   1. Check number
   2. Name of injured
   3. Address
   4. Age
   5. Sex
   6. Marital condition
   7. Number of children
   8. Nationality
   9. Knowledge of English
   10. Occupation
   11. Department
   12. Foreman in charge

(*b*) Facts as to injury
   13. Date of injury
   14. Day of week
   15. Time of day
   16. Place where accident occurred
   17. Department where accident occurred
   18. Cause of injury (immediate)
   19. Cause of injury (contributory)
   20. Nature of injury (abrasions, bruise, cut, and the like)
   21. Extent of injury (severe, slight, and so forth)
   22. Location of injury (left side, right side, second right finger)

(*c*) Facts as to time and cost
   23. Length of employment
   24. Witnesses to accident (name and address)
   25. Probable length of disability
   26. Date of return to work (or severity rate, in days)
   27. Number of working days lost
   28. Wages at time of accident
   29. Who treated the injury
   30. Amount of compensation paid

The above would seem to call for an undue amount of information as regards minor accidents but there is no certainty that a minor accident may not result in a major injury as in the case of infections. Moreover, once the occasion has been neglected it is impossible to recover the necessary facts. It is worse than useless to compile statistics and not use them, and therefore the happy medium should be sought. It is much better to do thorough work on a small portion of the problem than to have an ambitious though incomplete scheme. Every plant should have its accident statistics in such shape that they can be compared with records of previous years and those of other plants in the same industry so that they can be used for preventive purposes, and, also, for gaining a reduction in the rate of insurance.

The mere number of accidents occurring in a plant is insufficient to indicate the extent of the problem. One plant with 1,000 workers may have but 10 accidents resulting in the loss of a day each; another plant, of the same size, may have the same number of accidents in which the number of days lost is 15 or 20 times as great. Obviously the severity, as well as the frequency, of accidents must be taken into consideration, and both must be expressed in some comparable terms. The accident frequency rate is therefore expressed in the number of tabulatable accidents occurring per million hours exposed, and a "tabulatable accident" is one arising out of employment and resulting in any loss of time other than the remainder of the day on which the injury was incurred.

Severe accidents generally cause loss of time and, thus, the severity of an accident may be expressed in terms of the number of days lost per thousand hours worked. But there are certain types of accident which, though severe, involve little if any loss of time. A watchman, for instance, may have the joint of a finger removed without the loss of any time, but its severity, in terms of compensation awards, is far from negligible. In order to provide for such losses, and those involving death, resort is had to a "scale of losses" whereby such injuries are estimated in terms of days lost. Thus a death, or a total disability, is equivalent to a loss of 6,000 days. The dismemberment of a hand has as its equivalent 3,000 days, and so on. Table 61, on the following page, gives the scale adopted by the International Association of Industrial Accident Boards and

Commissions, by the United States Bureau of Labor Statistics, The National Safety Council, and other organizations.

TABLE 61

SCALE OF TIME LOSSES FOR DEATHS AND PERMANENT DISABILITIES

Nature of Injury	Days Lost	Disability—Percentage of Total
Deaths	6,000	100
Permanent total disability	6,000	100
Arm above elbow, dismemberment	4,500	75
Arm at, or below, elbow, dismemberment	3,600	60
Hand, dismemberment	3,000	50
Thumb, any permanent disability	600	10
Any one finger, any permanent disability	300	5
Two fingers, any permanent disability	750	12½
Three fingers, any permanent disability	1,200	20
Four fingers, any permanent disability	1,800	30
Thumb and one finger, permanent disability	1,200	20
Thumb and two fingers, permanent disability	1,500	25
Thumb and three fingers, permanent disability	2,000	33⅓
Thumb and four fingers, permanent disability	2,400	40
Leg above knee, dismemberment	4,500	75
Leg at, or below, knee, dismemberment	3,000	50
Foot, dismemberment	2,400	40
Great toe, or any two or more toes, permanent disability	300	5
One toe, other than great toe, permanent disability	.....	0
One eye, loss of sight	1,800	30
Both eyes, loss of sight	6,000	100
Both ears, loss of hearing	3,000	50

By the use of such a scale, in combination with a knowledge of the actual days lost, where determinable, it is possible to compare the rate of accidents in one plant with another and one period of time with another on equal terms. It is fortunate that for several years some of the greater industries of the country have compiled their statistics in this way through the agency of the various industrial sections of the National Safety Council. The statistics from the automobile and metals sections, given in Table 62, are typical of the facts secured.

Those figures provide food for thought. It may be seen at a glance that the automotive is safer than the metals industry. With about 60% of the automotive em-

TABLE 62

FATALITIES AND DISABILITIES IN THE AUTOMOTIVE AND METALS INDUSTRIES, 1923 [1]

Particulars	Industry Covered	
	Automotive	Metals
Average number of employees	186,564	112,202
Total number of hours worked	459,631,384	314,499,826
Number of accidents:		
Deaths	5	38
Permanent disabilities	138	309
Temporary disabilities	4,451	11,435
Total	13,723	14,233
Number of days lost:		
Deaths	30,000	228,000
Permanent disability	97,905	238,611
Temporary disability	45,183	292,354
Total	525,050	782,954
Accident frequency rate	29.86	45.26
Accident severity rate	1.121	2.489

ployees, the metals industry has nearly eight times the fatalities and more than twice the number of permanent disabilities. The temporary disabilities are about the same. All these facts are summed up in the two groups of figures representing the frequency and the severity rate; the first, expressed in the number of accidents per million hours worked, and the latter in terms of the number of days lost per thousand hours worked. Thus, in the metals industry almost 2½ days are lost for every thousand hours worked. It may be noted, in this connection, that in the railroads, according to the Interstate Commerce Commission, the average length of time worked by railroad employees in 1923 was 2,584 hours.

RESULTS OBTAINED IN ACCIDENT PREVENTION

Achievement in accident prevention, by such methods as have been outlined, can be estimated in terms of reduction in frequency and severity, and, in like manner, in a reduction of lost time and in cost.

---

[1] *National Safety News,* June, 1924, pp. 49, 51.

Under a plan of competition, conducted by the Worcester County Safety Council, including 24,383 employees in 1924 as compared with 23,419 in 1923, the number of accidents was reduced from 1,019 to 639, and the days lost were reduced from 16,764 to 10,819. Forty-five member firms competed, many of which were quite small.

Three years of accident prevention, ending December 31, 1923, have resulted, in the Standard Oil Company of New Jersey, in a reduction of 5% in the frequency rate of lost time accidents, and a reduction of 52% in the cost of accidents.

In the American Smelting and Refining Company the number of disabling accidents decreased from 2,749 in 1913 to 318 in 1921, or a 76% decrease. Simon Guggenheim, the president of the company, says, "The figures show that the policy of the company pursued in the education of its employees along safety lines has been efficient, economical, and from the humane standpoint, a great achievement."

The United States Steel Corporation has decreased its accident rate per thousand employees from 1906 to 1923 by 55.39%, during which time 36,374 employees have been saved from serious injury. The disabling accident rate was 70.20% less in 1923 than in 1912, and the aggregate number saved from injury, based on the 1912 rate, was nearly a quarter of a million.

The Sharon, Pennsylvania, plant of the National Malleable Castings Company won the 1924 inter-works safety contest with only 28 hours lost out of a total of 488,864 worked, a percentage of 0.0057.

In Henry Disston & Sons, Incorporated, Philadelphia, during 1924, the number of accidents causing lost time was only one-fifth of those in 1916 when an intensive safety campaign was started. With an average number of employees of 3,000 there were only 71 accidents, resulting in 1,174 days lost.

The insurance rate for steel manufacture of the same class as the Disston company is $1.20 for each $100 of wages paid. The rate of the company, however, was only 66 cents in 1924. Based on the above figures the company would have secured a saving of $75,000 on premiums alone in the last nine years.

The National Safety Council, in *Safe Practices, Number 43,* gives a list of nine companies with employees ranging from 500 to 17,000 whose reduction in days lost per thousand hours worked amounted on the average to over 70%.

The following figures show the reduction in frequency and severity of accidents due to the adoption of preventive measures in several representative companies:

TABLE 63

REDUCTION IN FREQUENCY AND SEVERITY OF ACCIDENTS, 1920, 1921

Industry	Frequency		Severity		Average Number of Employees	
	1920	1921	1920	1921	1920	1921
Tanks and pumps.	45 1	19 6	1 02	0 59	1126	932
Valves and fittings.	24 47	10 07	4 91	0 31	2580	1249
Power and light	58 6	24 7	2 09	1 59	830	750

The reduction in cost has been quite remarkable, in a number of other companies. The Chattanooga Street Railways had an accident cost of $120,010 in 1917 which was reduced to $16,152 in the first six months of 1922, the percentage of accident cost to revenue being 17.8 in the former and 3.5 in the latter year.

In the Sperry Gyroscope Company the number of hours lost per employee per year was 19.66 in 1918 and 1.41 in 1920, while the compensation paid per employee per year was reduced from $5.21 to 22 cents in the same period.[1] The plant employs 2,000 workers and the reduction resulted from a carefully planned organization, a systematic method of carrying on the work, and a carefully selected personnel.

Mr. Simon Guggenheim, referring to the savings effected in his organization, said: "Had the accident rate not decreased from the rate of 1913 the Employers' Liability Fund expenditures would have totaled $2,454,133 instead of $1,380,982. As the amount spent for accident prevention was $602,124, a probable saving is thus effected, in the cost of accidents, of $778,858."

---

[1] Lott, M. R. "Reducing the Cost of Accidents," *Factory,* May, 1921.

The American Rolling Mill Company had the following savings, in five months of the years 1918 and 1919:

TABLE 64

COMPENSATION, LOST-TIME ACCIDENTS, AND DAYS LOST, 1918, 1919, AMERICAN ROLLING MILL COMPANY

Year	Compensation		Lost Time Accidents		Days Lost	
	Total	Per 100 Men	Total	Per 100 Men	Total	Per 100 Men
1918	$20,638.22	$412 76	210	4 2	2,523	50 4
1919	1,340.26	38.29	83.2	2 3	868	24.8

THE MOST IMPORTANT FACTOR IN SAFETY WORK

The *National Safety News*, in November, 1923, asked, of some prominent leaders in the safety movement, what was the most important factor in safety work. There was a decided lack of unanimity to this question. Mr. Walter Teagle, president of the Standard Oil Company of New Jersey, suggested, "A trained leader." The Ford Motor Company believed that "complete guarding and redesigning of unsafe equipment" was the most important. Mr. H. F. Perkins, vice-president of the International Harvester Company, "Cooperation of employees; intelligent supervision and cordial support of the management." Mr. A. T. Morey, general manager of the Commonwealth Steel Company, found "sincere interest and backing of the management" to be essential, while Mr. S. F. Shattuck, of Kimberley-Clark Company, thinks that genuine interest of the foreman is the most essential factor in safety work. Here is a wide difference of opinion, yet all are true. The real situation is that each plant is a special problem requiring in one place leadership, in another machine guards, and in a third the cooperation of the foremen or workers. Thus, it is apparent that those who are responsible for the safety of the plant must analyze the facts and determine what special needs they disclose. It is always well to adopt the principle in safety work that the most important factors should be given attention first.

Nothing can be done without a thorough knowledge of the statistical facts. Secretary of Labor Davis, in January, 1925, has recommended to Congress provision for the collection of all information as to industrial accidents and their prevention, for which purpose a uniform statistical method used by all plants alike is an absolute necessity.

XVI

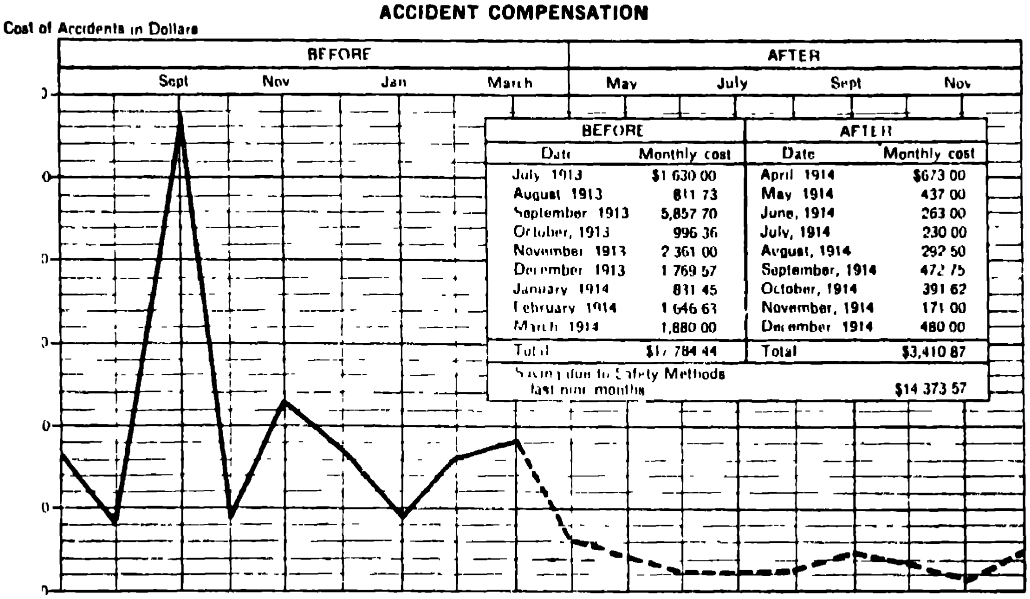
WORKMEN'S COMPENSATION

Methods of insurance. Private insurance companies Mutual insurance. State funds. Self-insurance. Waiting period Compensation and occupational disease. Types of compensation laws. Rate of compensation. Cost of compensation. Prevention or compensation.

A COMMON idea is that many obligations can be discharged by the mere payment of money. Hence we have workmen's compensation laws whereby a workman or his family—for he is sometimes killed—is paid for injuries arising out of or in the course of employment. New Jersey and Wisconsin passed the first effective law of the kind in 1911; another, which was declared unconstitutional in 1911 in New York, was passed in 1913. These laws deprive the employer of three customary defences in accident cases: negligence, assumption of risk, and fellow servant. The latter was invented only in 1837 and, as Augustine Birrel said, "Lord Abinger planted it, Baron Alderson watered it, and the devil gave it increase." Using these pleas it was possible for the employer to escape payment for injuries to workers. The folly of the whole business may be seen by the costs of one company for the nine months preceding and the nine months following the institution of the act in the state of New York. The results obtained are shown in graphic form in Figure 10, on the opposite page.

Deducting the cost of safety work, which amounted to about $6,000, there was a saving of nearly $12,000 for the year. In the first case the employer fought his employees and lost money; in the second he accepted the responsibility, introduced extensive safety work, and saved money.

Since the employer is obliged by law to compensate workers he has to insure against losses occasioned under



BEFORE		AFTER	
Date	Monthly cost	Date	Monthly cost
July 1913	$1 630 00	April 1914	$673 00
August 1913	811 73	May 1914	437 00
September 1913	5,857 70	June, 1914	263 00
October, 1913	996 36	July, 1914	230 00
November 1913	2 361 00	August, 1914	292 50
December 1913	1 769 57	September, 1914	472 75
January 1914	831 45	October, 1914	391 62
February 1914	1 646 63	November, 1914	171 00
March 1914	1,880 00	December 1914	480 00
Total	$17 784 44	Total	$3,410 87
Saving due to Safety Methods last nine months			$14 373 57

Figure 10: Chart showing a typical reduction in the cost of accidents for nine months before and after passage of workmen's compensation laws in New York State

the workmen's compensation acts. There are four alternatives:

1. Private insurance companies
2. Mutual insurance companies
3. State funds
4. Self-insurance

PRIVATE INSURANCE COMPANIES

In selecting one of these agencies the employer requires safety, service, and a reasonable cost. Private insurance companies must make a profit out of the business and they use a considerable proportion of the premiums received for expenses, amounting on the average to about 40% of the total. These companies have a plan whereby a reduction in the insurance rate may be obtained by a system of merits granted to plants which use certain means of preventing accidents. By this plan a plant which installs a medical department, erects guards, holds safety meetings, or does any one of those things which tend towards the prevention of accidents, secures thereby a reduction in its insurance rate. Thus there is a direct, as well as an indirect, saving effected by the installation of accident-prevention plans. The National Safety Council reports the following reductions in insurance rates by organized safety work:

TABLE 65

REDUCTIONS IN INSURANCE RATES IN SIX COMPANIES, 1922-1923

Name of Company	Rate per $100 Pay-Roll 1922	1923	Percentage Reduction
Edward Hines Yellow Pine Trustees.....	$4 18	$1.62	61.2
Nekoosa-Edwards Paper Company.......	.51	.26	49.0
Oliver Chilled Plow Works..............	.67	.24	64.2
Interstate Iron & Steel Company........	.70	.50	28 6
A prominent cement company...........	1 54	.95	38 2
Northern Indiana Gas & Electric Company	2 59	.53	79.5

In this way the private insurance companies encourage preventive work and, in effect, penalize the employer who has not attempted to reduce his accident risk.

MUTUAL INSURANCE

A mutual insurance association is one in which a number of companies insure themselves and, as in the case of the New Jersey Manufacturers' Casualty Company, or the American Mutual Liability Insurance Company, the cost of securing business is seldom more than 10% of the business done. In this type of insurance company a group of manufacturers in a given district band together, stand their own risk, and pocket the profit which would otherwise go to the old-time insurance companies. Mutual associations have, as a rule, centralized hospitals for dealing with accident cases and thus an additional saving is effected in administration expenses.

At the seventh annual meeting of the International Association of Industrial Accident Boards and Commissions, held in 1920, Mr. E. H. Downey, of the Pennsylvania Insurance Department, said:

> The expense and profits of stock companies, after deducting taxes, will average, over a period of years, about 35% of

the premiums, or 60% of the benefits. The corresponding expense ratio of reputable mutual companies varies from 15% to 20% of the premiums or from 25% to 33⅓% of benefits, and the management expenses of state funds range from 5% to 15% of premiums and from 6% to 25% of benefits. Stated in other terms, the overhead cost of carrying $1 in compensation benefits is about 60 cents by the stock companies, 25 or 30 cents by the mutual insurance plan, and something less than 10 cents by the plan of compulsory state insurance.[1]

STATE FUNDS

In the state funds, with assured stability, the cost of collection and disbursement is low. Mr. Bernard Shientag, at a hearing, February 13, 1923, stated that state insurance was the cheapest, being 27% less to employers in the general groups than the casualty insurance companies offered. The *Annual Report* of the New York State Department of Labor for 1923, however, states that, "the expense ratio for the last calendar year (1923) was 18.4%, as compared with 15.5% for the preceding year." Furthermore, "a bill . . . was passed at the last session permitting the State Fund to spend 25% of its gross premiums for operating expenses, instead of 15% as heretofore."

Out of the income of the New York State Workmen's Compensation Insurance Fund, 71.1% has gone to accident cost, 12.1% for expenses, 14.3% for dividends, and 7.2% for surplus.[2]

SELF-INSURANCE

In the New York workmen's compensation law provision is made so that an employer may arrange for the payment of compensation claims directly by himself to the worker, and this is called "self-insurance." It is really no insurance at all. The employer merely assumes payment for injuries to his workmen according to the schedule of the workmen's compensation law. Over 400 firms in the state of New York, including such companies as the Eastman Kodak Company, the Endicott-Johnson Company of Binghamton, and others, have adopted this plan. Under its operation the Sperry Gyroscope Company, in 1921, spent $9,755 in comparison with ordinary insurance costing $25,100. Its advantages are that there is no machinery, there need be no delay in settlements, the employer is stimulated to prevent accidents directly and the intimate relationship between employer and worker is secured and preserved.

---

[1] See, also, "Employers' Mutual Associations," W. S. Bucklin, Proceedings of the Conference on Social Insurance, *Bulletin Number 212, Bureau of Labor Statistics,* Washington, D. C.

[2] "State Insurance Fund," *Bulletin Number 9.*

During 1923 self-insurance was permitted to 424 employers and their subsidiaries in New York and, "there has never been a default in the payment of any compensation on the part of any employer granted the privilege of operating as a self-insurer." In Pennsylvania there are 515 self-insurers.

In the state of Connecticut, in the experience of Cheney Brothers, the cost of statutory accidents for the year 1922 was 35 cents for each hundred dollars of pay-roll. This company is a self-insurer and pays compensation in excess of that required by the state. The saving effected by self-insurance, in this instance, approximately offsets the cost of operating the medical department.

In the Hood Rubber Company, whose service manager is Dr. R. S. Quinby, the average disability per employee per year has been reduced from 0.85 days in 1917 to 0.32 days in 1921. The percentage of employees disabled yearly by industrial accidents has been reduced from 0.24 in 1917 to 0.10 in 1921. At the same time the cost of operation of the benefit plan (including compensation or benefits for sickness, accident or death) was approximately one-half the cost of reinsuring the plant in a commercial company. "After having paid losses, overhead expenses, taxes, and so forth, and placing in reserve sufficient funds to liquidate all outstanding liabilities, we have, at the end of two years' experience, 78% of the earned income unexpended."[1]

In order to become a self-insurer the employer files a written request with the State Industrial Commission for permission to carry the risk. The commission thereupon requests a financial statement from the employer in order to determine his ability to shoulder the risk. Permission is granted if the employer deposits securities equivalent to six months' premiums he would have to pay the state. The employer must submit a semiannual statement showing the number of employees, the wages paid, and the outstanding accident losses for the period. In addition there must be submitted a monthly statement of the number of employees and the pay-roll figures for each class. Finally the employer must maintain a safety organization and a first-aid service.

The efficiency of the various methods of insurance, as far as the worker is concerned, may be judged by the promptness with which payments are made to the workers as compensation for injuries. The following figures give information on this subject for the first half of 1924 in Wisconsin.

TABLE 66

TIME OF FIRST INDEMNITY PAYMENT OF COMPENSATION FOR INJURIES IN WISCONSIN, 1924[2]

Particulars	Within 15 Days of the Time of Injury	After 15 Days from Date of Injury
All Wisconsin Mutual Companies...	66.8	33.2
All Stock Companies	63.0	37.0
Private Self-insured Employees....	53.5	46.5

Private insurance companies determine the insurance rate by estimating the risk on the basis of the accident rate in the different industries, from which is compiled a schedule of rates. On the basis of this schedule and in conjunction with an examination of the individual plant, its accident experience and its equipment for accident prevention the individual insurance rate is determined. The scheduled rating may be reduced by additional guarding, first-aid service, and increased safety measures.

---

[1] Quinby, R. S. "Claim Costs Reduced by Health Supervision," *Nation's Health,* January, 1923, p. 35.

[2] Wisconsin Labor Statistics, September, 1924.

Workmen's compensation laws, according to Carl Hookstadt, tend to include diseases within the range of compensation. The waiting period (the time which elapses between the date of injury and the date upon which the injured person is entitled to compensation) has in the past few years been decreased by seven states and, in some cases, has been abolished when disability is prolonged. In five states the percentage of compensation has been increased and the weekly maximum has been increased in nineteen states, as have the benefits in thirteen states. This is sufficient evidence of the tendency to liberalize the compensation acts. Forty-two states, the territories of Alaska, Hawaii, and Porto Rico, and the Federal Government now have workmen's compensation acts.

There are different types of compensation laws. A compulsory compensation law requires every employer within its scope to accept the act and pay the specified rates of compensation. The elective type is one which gives the employer an option but, in case he rejects, the customary common law defence is abrogated. Fourteen states have compulsory and thirty-one have elective compensation laws. In the case of the former, insurance is required in all but one state. In the latter group, insurance is not required in three states.

Employers in eight states must, and in nine, may insure in a state fund; in thirty-three states they may insure with private insurance companies and in the same number of states self-insurance is allowed. With the exception of eight states, employers have options on several kinds of insurance.[1]

No state covers all employees. New Jersey includes all but casual labor, public officials, and employees receiving more than $1,200 per year. The usual exemptions are non-hazardous employments, agricultural labor, domestic service, plants with only a few employees and casual labor. In thirteen states only hazardous employments are included.

---

[1] Hookstadt, Carl. "Workmen's Compensation and Social Insurance," *Monthly Labor Review*, January, 1923, p. 158.

Eleven states and territories—California, Connecticut, Hawaii, Illinois, Massachusetts, Minnesota, New York, North Dakota, Ohio, Porto Rico, Wisconsin—and the Federal Government include occupational diseases among those which may be compensated. Five states have amended their acts to this effect during 1922 and 1923, and in Minnesota, New York, New Jersey, and Ohio the coverage is limited to certain diseases.

In most of the states, an injury entitling a person to compensation must cause disability for a certain time, before which no compensation is due. This is called the "waiting period." Up to January, 1924, thirty states had a waiting period of one week or less. In April, 1924, the New York State Legislature passed the Moore-Reyburn bill reducing the waiting period from fourteen to seven days, to be operative from January 1, 1925. Under this plan the number of injured employees entitled to compensation will be increased by about 50%. The importance of shortening the waiting period is that most accidents cause but a short period of disability and, therefore, a comparatively few of those who are injured come under the operation of the laws as they stand.

The rate of compensation varies in detail. Generally speaking, deaths are compensated for at the rate of 300 weeks, amounting to $4,000 maximum; permanent total disability entitles a worker to about 400 weeks, or $5,000, maximum and partial disability about 300 weeks, or about $3,000 maximum. In all but two states the amount of compensation is based on wage rates. In nineteen states the rate is 50%; in three states, 55%; in nine states, 60%; in three states, 65%, and in nine states, 66⅔% of the wages. These rates are modified by maximum and minimum amounts, and in most states the employer bears but 20% or 30% of the cost of accidents.

The Bureau of Workmen's Compensation of the State of Pennsylvania received reports of 200,435 accidents up to the end of 1923. The compensation awarded amounted to $13,143,393, of which $5,898,939 was for death, $2,873,-418 for permanent disability, and $4,370,973 for temporary disability. Ninety-seven per cent of the cases were settled by voluntary agreement, while only 3% were contested before the referee. The average payment since 1916 was $48.38 per case.

PREVENTION AND COMPENSATION

The United States Steel Corporation, between January 1, 1912, and December 31, 1923, spent $11,951,432 on accident prevention, and $37,215,177 on relief for injured men and the families of men killed; 24.3% and 75.7% respectively. The precedent is one not to be followed. The hazards of the iron and steel industry are high and, therefore, the expenditure on prevention should be liberal since it is better to spend money on prevention than on compensation. A company in New Jersey, with much less hazard, spends eight times as much on prevention as on relief, and compensates its employees on a more liberal scale than is necessitated by the New Jersey workmen's compensation law. Though the evidence is far from extensive it may be accepted as a general rule that the cost of prevention should be at least equal to that of relief, especially in the earlier stages of safety development. It is not a general custom, though it should be, to ascertain the cost of preventive work, including the erection of machine guards, salaries of safety men, and time spent by employees on safety meetings. When these figures are ascertained it is possible to determine whether prevention or compensation will be the more economical.

HEALTH MAINTENANCE IN INDUSTRY

PART IV

PLANT HYGIENE

XVII

VENTILATION

Present conditions. Importance of ventilation. Elements in ventilation. Temperature. Humidity. Air movement. Purity. Causes of bad air. Nature of air constituents. Temperature in the shops. Comfort zone and temperature. Methods of ventilation; structural and mechanical. Ventilation and output. Ventilation and sickness.

HEALTH depends on air supply. A person can go for days without food or water, but privation of air for even a few minutes causes death. Pure air is invigorating and, therefore, is particularly necessary to production. Lack of a good and plentiful supply is one of the tragedies of industry which can be, but usually is not, amended more easily than any other equally important cause of ill health. Natural ventilation is often inadequate more because the means at hand are neglected than because of the pollution of the air by industrial processes. Ventilation, as we shall see, is not a simple problem, but much bad ventilation can be avoided even though heat, humidity, and stagnation are contributing factors. "The commonest evil in the field of air conditioning is the slight but highly objectionable overheating which obtains in the ordinary window-ventilated factory workrooms where there is no marked overcrowding and no special process tending to overheat." [1]

"Of 113 offices investigated in a large and comparatively new office building, 33% had no artificial ventilation, and in only 61% of the rooms had any attempt been made in this direction." Throughout the building 74% of the offices were either not ventilated or were ventilated insufficiently. Plant conditions are somewhat different; usually they are more open and less surrounded by other buildings but very often the evolvements in process offset the advantages.

---

[1] Winslow, C.-E. A. "Notes on the Efficiency of Various Systems of Air Conditioning," *Public Health Reports*, February 10, 1922, p. 275.

The Policyholders' Service Bureau of the Metropolitan Life Insurance Company recently surveyed 54 foundries and found the following conditions as regards ventilation:

TABLE 67

VENTILATION IN 54 FOUNDRIES

Ventilation System	Number	Percentage
Natural (provided by plant construction)	20	37.0
Artificial system (air conditioning)	5	9.2
Simple blower system	8	14.8
No special provision (construction inadequate for proper ventilation)	21	39.0

Ventilation is, in fact, a complex subject, having in its elements a number of constituents, each of which varies in action and importance with varying circumstances. Ventilation is the maintenance of the proper temperature, diversity, humidity, circulation, and purity of air in confined spaces in order to secure the most healthful conditions.

The American Society of Heating and Ventilating Engineers, at its annual meeting, January, 1924, has proposed the following definition of good ventilation:

> Ventilation perfection is attained when the atmospheric condition in every part of a room occupied by human beings is continuously maintained with normal amount of oxygen and free from dust, bacteria, odors, and poisons, with suitable air movement and at the temperature and humidity shown within the comfort zone. . . .

Employers give little direct attention to the ventilation of working places and are often unaware of its effect on production. The subject, in fact, is seldom mentioned in managerial circles; no one has charge of the matter and each department acts independently, or fails to act, as does each individual. Any relation with the problem as regards human beings is casual. On the other hand, the self-constituted regulator of ventilation consults his own individual taste regardless of the needs of others and this stirs up a good deal of trouble in many shops, sometimes even leading to fatal results. In the Illinois Malleable Steel Company, May, 1924, one of the employees opened a window, another promptly closed it; there was a controversy in which several other employees took part; this led to a fight resulting in two deaths.

When the process itself demands air-conditioning, a competent ventilating engineer is hired and an elaborate ventilation system is installed to meet exacting industrial requirements. In a film studio, for instance, there is an automatic system for heating and damping the incoming air so as to facilitate the taking of moving pictures; in steel plants, while the working conditions are far from agreeable, the steel-sheets are stored in a warehouse so ventilated that there is only a slight variation in either temperature or humidity. These conditions are characteristic: great achievement in ventilation for process, little for the worker! Hill and Campbell, in describing efforts to study the ventilation problem in some plants, found that, "No one seemed interested in the matter and no one was sufficiently skilled to regulate the ventilation in order to produce a suitable cooling power." As yet, comparatively few industrial physicians include a knowledge of ventilation in their training. This deficiency is now being met by the Harvard School of Public Health which has provided training on factory ventilation, lighting, heating, and allied subjects.

The effect of ventilation on production is marked. Winslow, for instance, found that, "Our subject did about 85% as much work under optional conditions at 75 degrees as at 68 degrees, and at 86 degrees the work performed fell to 72%. . . . As compared with fresh air at the same temperature, vitiated air reduced the performance of physical work by 9%."[1] Although this is an isolated experiment, carried out under experimental conditions, it is indicative of great possibilities.

---

[1] Winslow, C.-E. A. "Window Ventilation Preferred for Schools," *Nation's Health,* December, 1922, p. 758.

The importance of ventilation, air-conditioning, and the like, has, in fact, been fully realized in manufacturing processes; in some cases goods cannot be made without rigid air-conditioning, and hence it is accomplished voluntarily. In contrast, legal enactments have had to be introduced in order to compel the provision of good ventilation for workers. The New York State Industrial Code, Rule Number 86, provides that:

> Each workroom shall have proper and sufficient means of ventilation and shall be kept properly ventilated. If excessive heat be created, or if steam, gas, vapors, dust, or other impurities render the air unhealthful, the room must be ventilated in such a manner as to render them harmless, as far as practicable. . . . Proper degrees of temperature shall be maintained during working hours.

Such rules as the above are vague and uninformative since they are intended to apply to general industrial conditions and, in so far as they are followed, they do help to maintain health. But what should interest the employer most keenly is the effect of good ventilation on production, a field which has hardly been touched, outside academic circles.

Various requirements have been specified for the purpose of indicating the necessary air supply as an indirect means of securing good ventilation. In ordinary occupations the worker requires 1,500 cubic feet of a positive supply of uncontaminated outdoor air per hour and, in addition, each worker should have 250 cubic feet of air space—20 square feet when the ceiling is over 12½ feet high and usually a minimum of 25 square feet—the air supply entering at a low velocity. Another way of accomplishing the same purpose is to ensure frequent changes of air in a given space, "A standard of six changes of air per hour, the ventilation being distributed as evenly as possible throughout the room, should be regarded as a minimum in ordinary cases." Where air is provided artificially the inlets should be of sufficient area to prevent draughts and, generally, means for heating and cooling the air should be provided.

THE ELEMENTS IN VENTILATION

As has been already indicated, ventilation is complex. Its elements are temperature, diversity, humidity, movement, and purity, and they must be considered in relation to each other and to the whole, in order to secure the "Practicotatum" which Dr. Winslow Pierce defines as, "A combination of the atmospheric factors of gases, light, heat, pressure, and moisture at which the life functions of metabolism (chemical changes of the body) assimilation, transpiration, growth, and so forth, are at their greatest efficiency." [1]

Within the extremes of each of these elements must be found that point which, in combination with the others, constitutes good ventilation. They are as follows:

Factor	Desirable	Undesirable
Temperature.	Cool	Heat
	Slight changes	Unchanged
Humidity....	Dry	Wet
Circulation..	Movement	Stagnation
Purity.......	No dust	Dust
	No gases	Gases, fumes

As shown above, good ventilation lies between two extremes, and certain tendencies towards one or the other are to be preferred: cool, rather than hot, air; slight changes rather than a constant temperature; dry, rather than excessively moist, air; movement rather than stagnation, and physical, rather than chemical, purity, and all of these within comparatively narrow limits.

In an investigation made by C. P. Yagloglou it was shown that temperature, humidity, and air movement may vary yet produce the same effect, such combinations being called "Equivalent Conditions." [1]

---

[1] Pierce, W. D. "Air Conditioning, Longevity and Health," *Nation's Health,* September, 1922, p. 563.

THE CAUSES OF BAD AIR

Numerous conditions, arising out of manufacturing processes and materials, cause bad air. Furnaces, boilers, hot metals and apparatus cause heat; the combustion of gas, coal, and other fuels produces not only heat but fumes, gases, and the like. Closed windows and doors, rooms of insufficient area, overcrowding and failure to adjust air inlets and outlets tend to maintain the temperature at a constant level. The use of steam and hot water—as in laundries—and the boiling of certain substances create undue humidity. Certain mechanical operations necessitate a still atmosphere and hence stagnation results; others, as in furnace work, are done in sheds and hence there is excessive draught. The dusty processes—cement making, stone cutting, and handling grain—increase the physical impurities of the air, while certain chemical operations generate gases, such as carbonic oxide, nitrous oxide, which also affect the chemical purity of the air. In addition, places not properly or regularly cleaned generate foul smells, bacteria, and dirt, as in the use of animal matter and the accumulation of by-products. Some such condition is to be met with in most plants. They reduce the working capacity of the employee and predispose him to headache, dizziness, and sickness.

THE NATURE OF THE AIR CONSTITUENTS

The object of ventilation is to remove bad air either by dilution or replacement, to regulate its temperature, to maintain the right amount of moisture, to control air movement, and to obtain chemical and physical purity.

---

[1] Yagloglou, C. P. "Modern Ventilation Principles and Their Application to Sedentary and Industrial Life," *Journal of Personnel Research*, February-March, 1925, p. 375.

Temperature is an all important factor in ventilation as well as in certain manufacturing processes. Chocolate dipping, cold storage, and some crystallizations need low temperature, while japanning, drying, vulcanizing, and heat-treating require high temperatures, but all within narrow limits. The worker, himself, must maintain a certain bodily temperature within a very slight range otherwise he becomes sick. He is, however well able to accommodate himself to external conditions, affected by them to some degree. The highest death-rate, for instance, occurs in cold weather and decreases up to a temperature of about 60 degrees, between which point and 75 degrees mortality is at a low rate. Beyond this point there is a rapid increase in the death-rate.

In like ratio the working capacity is affected by temperature. It is sometimes too cold and sometimes too hot to work at all, and even within a comparatively narrow range the rate of output varies materially. The New York State Ventilation Commission ascertained the relation between output and temperature as shown in the following table:

TABLE 68

RELATION BETWEEN OUTPUT AND TEMPERATURE

Temperature (Degrees F)	Reduced Working Capacity
68	....
75	17%
85	37

Were such conditions to obtain generally, and if easily demonstrable, much more attention would be given to the subject. However, high temperatures do exist at certain times and in certain places. It is not unknown for steel furnaces to have to discontinue work altogether on very hot days. The subject, however, continues to be neglected and the following quotation from a departmental report is not unique:

Although having tried repeatedly to get relief from Mr. ......

> (the plant engineer) regarding ventilation, I have been unable to get any improvement. Ventilation is such that even now (March) some girls have to stop work or actually get sick through want of air. . . . The average temperature is 74 to 84 in some places and 88 to 90 in one corner. . . . I think we will have great difficulty in retaining good help in this room when the warm weather sets in.

The remarkable thing about this particular case is that the condition occurred in a comparatively new plant.

Varying conditions of work demand different temperatures. Except in the extreme north and south of the United States it is generally possible to aim at and secure a temperature ranging from 60 to 70 degrees, about 65 degrees F. being the most suitable for general needs. With hard work a lower temperature is desirable, say from 55 to 60 degrees, but a higher temperature should be maintained for intermittent work. Where there is light hand work the temperature may range from 60 to 70 degrees for maximum comfort.

For most ordinary occupations, 65 to 68 degrees is most agreeable, particularly if the relative humidity is no more than 50%. The following table indicates the approximate range of suitable temperatures:

TABLE 69

RANGE OF SUITABLE TEMPERATURES FOR VARIOUS ROOMS

Rooms	Temperature (Degrees F.)
Workrooms—vigorous work	55-60
Workrooms—intermittent, quick work	60-65
Workrooms—general	65-70
Washrooms	60-70
Office	65-70
Dressing-rooms	60-70
Locker-rooms	60-70
Toilet-rooms	55-68

Temperature, however, is affected by the amount of moisture in the air, its velocity and purity. Workers produce less in an unvarying temperature than one which changes, inside, as in the outer air. If the air is stagnant the working temperature should be lower than where there are frequent though not wide changes. Humidity makes the effects of temperature more apparent, while an increased velocity of wind reduces the discomfort. Although high temperature does not affect the purity of the air it is injurious to health, causes fatigue, lowers vitality, and renders workers prone to sickness.

In an investigation made by C. P. Yagloglou under the combined auspices of the Research Laboratory of the American Society of Heating and Ventilating Engineers, the United States Bureau of Mines, and the United States Public Health Service, it was ascertained that the optimum temperature for rest or light work, in still air and normal clothing, was found to be 64.5 degrees "effective temperature." [1]

The temperature may be regulated either by warming the cool air or by cooling the hot air and having a thermometer to indicate the existing condition. The first step, in temperature regulation, is the placing of thermometers in suitable positions, the establishment of a method of ascertaining the temperature at a given time, and means for correcting temperature in case of abnormal conditions.

A thermometer should be placed in each working room, about 5 feet from the ground, for every 2,500 square feet of floor space. This will not, of course, regulate the temperature, but it will provide means of ascertaining abnormal conditions and showing the need for correction. Therefore, the thermometer should be inspected daily with a view to the establishment of proper working conditions. This can also be secured by thermostatic control. Daily checking of temperature in the case of human beings might seem to be superfluous; this is not the case in regard to products.

---

[1] Yagloglou, C. P. "Modern Ventilation Principles and Their Application to Sedentary and Industrial Life," *Journal of Personnel Research*, February-March, 1925, p. 375.

The Eastman Kodak Company has a full system of temperature control, for its product. The Western Electric Company, in order to prevent spoilage of foodstuffs, checks the temperature of each ice-box and cooling room hourly through the entire day and night; and in a certain plant cafeteria the temperature was 88 while the outside temperature was 74 degrees.

The real importance of temperature regulation from a managerial point of view is that it affects the output of the workers. A report issued on "Variations in Efficiency in Cotton Weaving" by the Industrial Fatigue Research Board (England) based principally on hourly output of 600 looms over a period of a year shows clearly that productive efficiency falls off distinctly in a temperature of over 75 degrees Fahrenheit.

HUMIDITY

Humidity is the moisture or vapor in the air which varies with the temperature, increasing as temperature increases, up to saturation. Absolute humidity is the amount of moisture in the air; relative humidity is the ratio between the amount of moisture and the saturation point at any given temperature. It is the relation of absolute to positive humidity. Air is said to be saturated when it can absorb no more moisture at a given temperature. If this temperature is lowered, moisture will condense on surrounding objects; hence the fogginess on a glass of iced water. If the temperature is raised, the air absorbs more water since it has greater absorptive capacity at higher temperature. The dewpoint is the temperature at which a given sample of air becomes saturated and starts to condense.

Humidity is necessary in certain manufacturing operations. In textile mills, for instance, the drying out of cotton or woolen fibers makes them brittle; moreover, dry air increases the possibility of static electricity. But the humidity that makes economical manufacture possible decreases the working capacity of the operative. It is a commonly experienced fact that men in a hot and humid atmosphere feel a disinclination to work. Results show this definitely. When a worker is subject to the combination of high temperature and humidity his bodily temperature is raised, his working power reduced, and he is predisposed to that bane of industrial efficiency, the common cold.

The deleterious effect of undue humidity is recognized to such an extent that various ordinances are in force to protect the worker. The New York State Law, Sec. 86, states that: "The person operating every factory shall provide . . . proper degrees of . . . humidity . . . at all times during working hours." The Chicago ordinance requires that the humidity of factories be kept between 40% and 85%. The normal humidity of the air is about 65 with a temperature of 68 degrees Fahrenheit, and this is acceptable for most working conditions.

The relation between temperature and humidity is important. High temperature and low humidity are often more comfortable than low temperature and high humidity. Sensitivity to heat is increased by high humidity; that is why a worker feels at one time comfortable, at another time uncomfortable with the thermometer showing the same degree of heat. What it does not show is the accompanying humidity. It is evident, therefore, that the temperature, as shown by the ordinary thermometer, is far from being an efficient indicator of satisfactory working conditions.

As the temperature increases, its capacity for holding humidity also increases and men become less inclined to work, if the air does hold an increased amount of moisture. Therefore, the thermometer is an insufficient indicator of atmospheric conditions. "The combination of temperature and humidity records, as shown by the wet bulb thermometer, is the only reliable index, and it places maximum comfort for men at 68 wet bulb, while actual symptoms occur at 78 wet bulb."

THE COMFORT ZONE AND TEMPERATURE

The chart on page 336 indicates the comfort zone of humidity at a given temperature, within which is found the optimum of comfort.

Table 70, below, indicates temperature and humidity in relation to working ability, according to H. Dwight Pierce.[1]

TABLE 70

TEMPERATURE AND HUMIDITY IN RELATION TO WORKING ABILITY

Degrees F.	Humidity	Working Ability
80	20%	No discomfort
80	65	Discomfort
80	80	Rest necessary
80	100	Hard work impossible
70	2 to 75	Work without discomfort
70	. 40	Greatest comfort
70	85	Comfort when inactive
70	91	Depressing fatigue
90	25	No discomfort
90	50	No work should be done
90	65	Hard work impossible
90	81	Body temperature rises
90	90	Dangerous to health

Keeping the air in proper condition necessitates either its moistening or drying as occasion demands; the method depends on the heating system. If there are hot-air furnaces, pans may be put in the hot-air ducts with an automatic water supply for moistening the air. If steam and hot water are used, "perhaps the best method is a recently patented device whereby a metal pan covered by a grating is placed on the radiator. In the pan lies a coiled pipe connected with the source of heat and it can be operated independently of the radiator. The water put in the pan is heated by the coil and kept at a much higher temperature than if heated solely by the radiator."[1] This plan, while much more efficient than the ordinary devices, is hardly sufficient for large factory rooms. The trouble with most contrivances of the sort is that they provide only an infinitesimal amount of the moisture needed.

---

[1] Pierce, Dwight H. "Air Conditioning, Longevity, and Health," *The Nation's Health*, September, 1922, p. 563.

In indirect heating systems the air is warmed by passing over pipes heated with steam and is then blown into the rooms. First, there is a humidifying chamber, then come the radiators heating the air before and after humidification. Fans drive the air through the building and ducts carry the air to the rooms. To humidify the air the water is heated by steam pipes and falls on to paddles which break it into spray. The air, partly warmed by the steam pipes, passes through the sprayed water and absorbs it to saturation. Surplus moisture is removed by baffles.

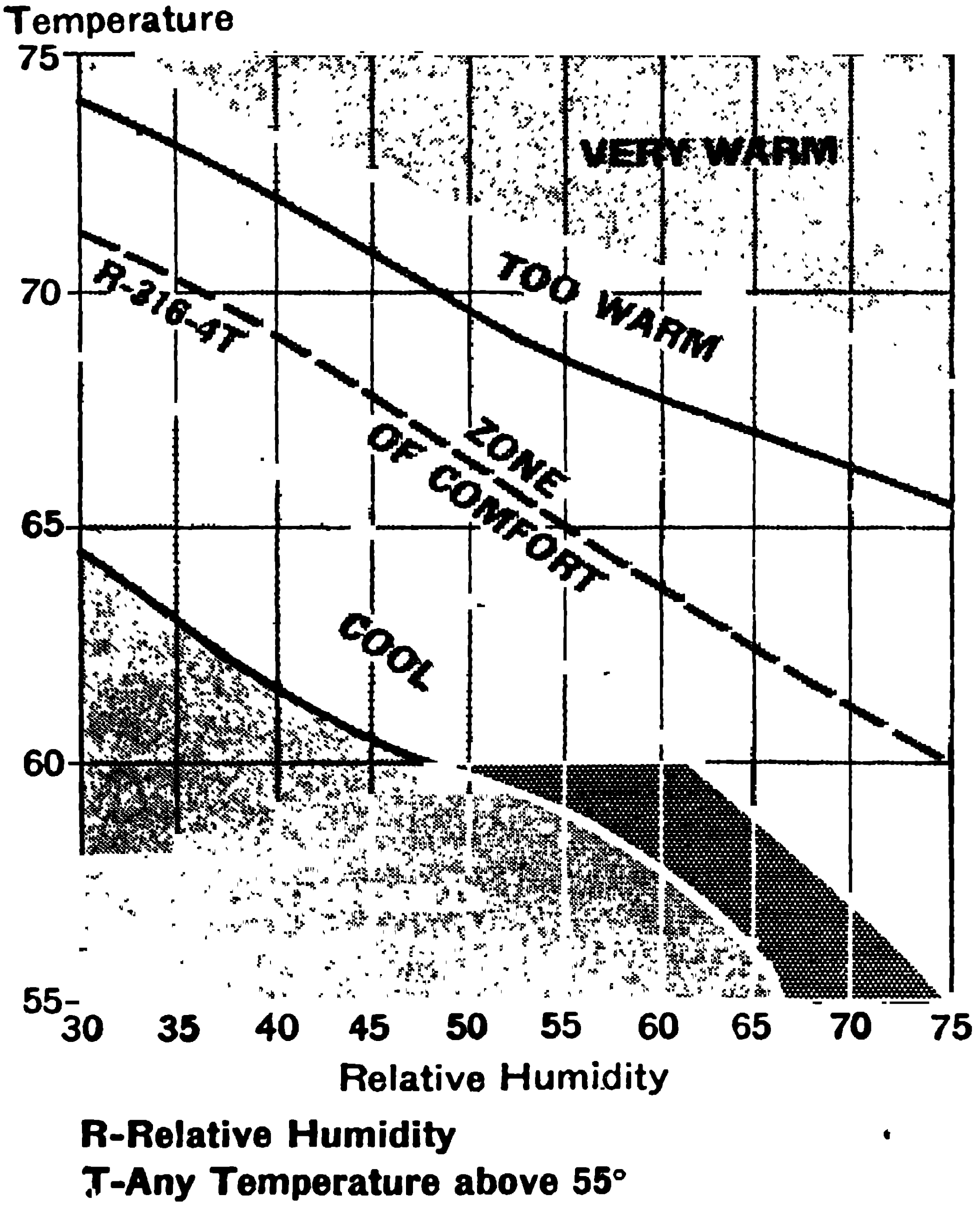
The degree of humidity given to the air can be controlled. It depends on the difference between the air as it leaves the humidifier and when it reaches the rooms. If the temperature should be equal in both places the humidity will be 100%; but if they differ by 20 degrees, the humidity will be about 25%. This system can be used to cool and dry the air in summer and warm and moisten the air in winter.

Humidity is determined by means of the hygrometer, psychrometer, or wet and dry bulb thermometer. Two thermometers, exactly alike, lie together; one is covered by a damp muslin sleeve. The evaporation due to air movement, minus humidity, reduces the temperature on the wet bulb thermometer and thus shows the humidity. The fact that there is no standard of moisture or of muslin on the wet bulb probably affects the accuracy of the reading. The sling psychrometer is an arrangement whereby the thermometer can be swung rapidly in order to increase evaporation. The dryer the air the greater the drop in temperature.

The wet and dry bulb thermometer is, according to Hayhurst, "the most valuable instrument and should be placed in almost every place of human habitation. The sling psychrometer is the best; it records "sensible temperature

---

[1] Huntington, Ellsworth. "The Purpose and Methods of Air Control in Hospitals," *Modern Hospital,* May, 1920, p. 348.



Courtesy Chicago Commission on Ventilation

Figure 11: Chart showing relationship between temperature and humidity

as well as actual." In the Greenfield Tap and Die Corporation a hygrometer is in plain sight so that the moisture may be regulated when humidity is too high.

The physical comfort felt by workers, upon which output depends to some extent, is not fully indicated by the ordinary thermometer which merely shows the existing degree of atmospheric heat and indicates, therefore, only the amount of body heat lost by convection and radiation. But, as has been shown, the heat mechanism of the body is regulated by the evaporation of perspiration and the rate of the latter is determined by the amount of humidity in the air.

Since bodily comfort is determined by evaporation as well as radiation and convection the kata-thermometer is used to measure the loss due to all these factors. The kata-thermometer consists of wet and dry bulb thermometers with a range of 95 to 100 degrees Fahrenheit. The dry kata-thermometer is heated to above 100 degrees Fahrenheit, and the time taken in cooling from 100 degrees to 95 degrees indicates the temperature loss due to convection and radiation A factor, on the thermometer, divided by the time of cooling in seconds, gives the cooling power in millicalories per square centimeter of cooling surface per second. The wet kata-thermometer cooling power is similarly found. The bulb has a muslin covering which is damped and the thermometer heated as above. The difference between the two indicates the evaporative condition of the air.[1]

The United States Public Health Service has made extensive tests of humidity and temperature in relation to air movement and it has been uniformly found that when the air was stagnant bodily temperature and pulse rate increased, there were sensations of discomfort, dizziness, and profuse perspiration. When there were air movements, other conditions remaining the same, these symptoms disappeared. There is, in fact, an intimate relationship between circulation of air and human comfort. The air of factory rooms, to be suitable for maximum production, should be in a state of constant though gentle movement. This circulation of air is one of the most important considerations of ventilation which is quite often neglected. Air in motion has great cooling powers; in fact, warm air in motion is more cooling than cool stagnant air, merely because it promotes evaporation and thus reduces the body heat. Moreover, moving air, even if it contains exhaled carbon dioxide, is more invigorating than pure but stagnant air. Cooling the body by means of air currents brings about that physical condition whereby more production is possible and hence the importance to plant managers bent on securing maximum output. Under experimental conditions very substantial results have been obtained in output by the mere device of providing a draft of air. "A small fan, with a capacity of about 2,000 cubic feet of air per minute, operated about 10 to 20 feet from the worker, may

---

[1] McConnell, W. C., and Yagloglou, C. P. "The Kata-Thermometer, Its Value and Defects," *Public Health Report*, September 5, 1924. See, also, Orenstein, A. J., and Ireland, H. J. "Experimental Observations upon the Relation between Atmospheric Conditions and the Production of Fatigue in Mine Laborers," *Journal of Industrial Hygiene*, January, 1922, p. 30.

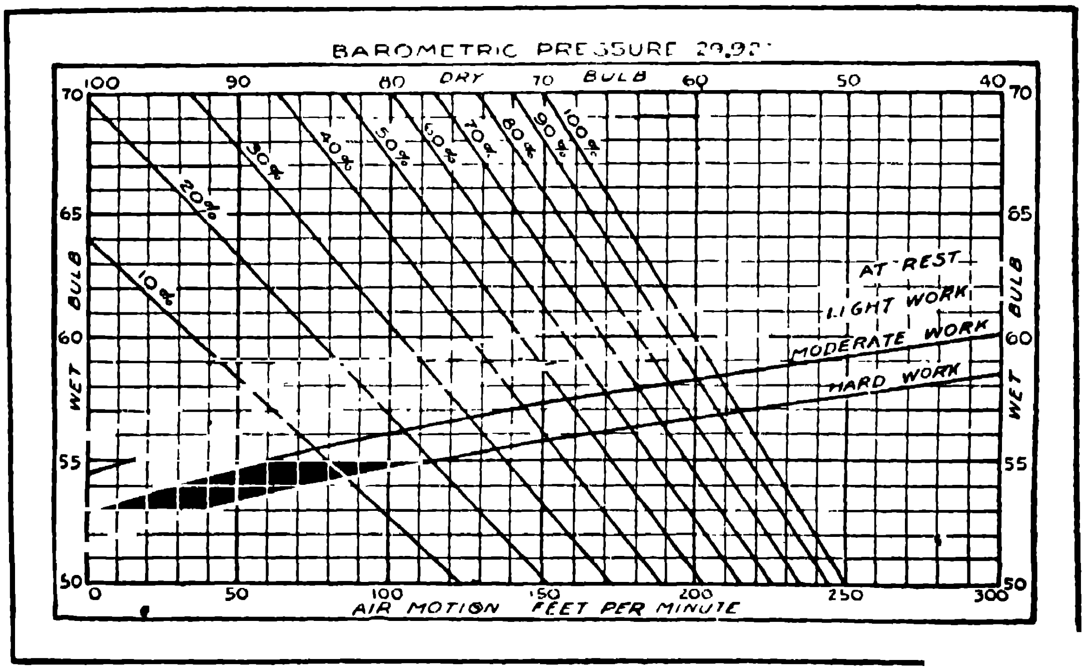


Figure 12: Chart showing relationship between temperature, humidity, and air motion

increase the output (under experimental conditions) by as much as 46%."[1] Even if this is an extreme example there is a germ of truth in it that should not be lost on plant managers. Dr. E. Vernon Hall, of the Chicago Health Department, has prepared the chart on the opposite page to show the relation between temperature, humidity, and air motion in securing the best atmospheric working conditions.

There is a vital difference between one velocity of wind and another. A moderate circulation of air causes a pleasant and even drop in temperature; a high velocity causes a quick drop in the bodily heat. In the first case the reaction is effective and beneficial; in the latter it may be disastrous, the result of draft. A draft is that velocity of wind which cools too suddenly. Clothing, saturated with perspiration, causes a much quicker drop in temperature of the body than dry clothing in the same velocity of wind.

The physical properties of the air need some consideration. A narrow stream of sunlight into any dark room discloses the presence of a vast amount of particles floating in the air, some of which are harmless. Other sorts of dust, however, pollute the air without being apparent or even causing smell. Smell, which may be harmless, is usually the supposed proof of impure air, yet such deadly poisons as carbon monoxide have no smell. The dust is harmful mainly because it irritates or clogs the breathing mechanism, as has been shown in the chapter on occupational dusts.

Chemical purity hardly exists. Ordinarily air contains some extraneous gases, but ventilation is necessary, not because of carbon dioxide given off in breathing, nor for lack of oxygen, but generally to get rid of superfluous heat either generated in working or coming from external sources The poisonous effects of carbon dioxide have been much discussed, but it is the accompanying circumstances of stagnation, heat, and lack of circulation, that make its presence harmful. The body can tolerate a considerable amount of carbon dioxide in an otherwise good atmosphere.

---

[1] Orenstein, A. J., and Ireland, H. J. "Experimental Observations upon the Relation between Atmospheric Conditions and the Production of Fatigue in Mine Laborers," *Journal of Industrial Hygiene*, 1923, Vol. IV, p. 91.

In the final report of the New York State Ventilation Commission the following conclusions were reached as regards the subject: [1]

> The experiments of the commission have in general confirmed the conclusion of earlier investigators that the first and foremost condition to be avoided in regulating the atmosphere of occupied rooms is an excessively high temperature. We have found that even slight overheating (24 degrees C., or 75 degrees F.) produces the following harmful results:
>
> 1. A burden upon the heat-regulating system of the body leading to an increased body temperature, an increased heart rate, and a marked decrease in general vaso-motor tone as registered by a fall in the Crampton index.
> 2. A slight but definite increase in the rate of respiration.
> 3. *A considerable decrease in the amount of physical work performed under conditions of equal incentive*—a decrease amounting to 15% at 24 degrees C. (75 degrees F.) and to 28% at 30 degrees C. (86 degrees F.).
> 4. A markedly abnormal reaction of the mucous membranes of the nose, leading ultimately to chronic atrophic rhinitis and, when followed by chill, producing a moist and distended condition of the membranes calculated to favor bacterial invasion. . . .
>
> For these reasons we believe that the dangers of room overheating are far more serious in their effect upon human health and efficiency than has generally been realized and that every effort should be made to keep the temperature of the schoolroom, the workroom, and the living room at 20 degrees C. (68 degrees F.) or below.
>
> With regard to the problem of relative humidity it is obvious that a high moisture content combined with high temperature must always be harmful, since the effect of a humid atmosphere is to decrease the heat loss from the body by evaporation. . . .
>
> Our results in regard to the influence of the chemical composition of vitiated air (temperature and humidity effects being

---

[1] *Ventilation; Report of the New York State Commission on Ventilation,* p. 199. E. P. Dutton & Company, New York, 1923.

excluded) have been generally negative. In two respects, however, our experiments suggest that some chemical constituents of the air of an unventilated room may be objectionable. Such air appears (1) to decrease the appetite of human subjects for food, and (2) to diminish substantially the amount of physical work performed under conditions of equivalent stimulation.

We may conclude, then, that the primary condition of good ventilation is the maintenance of a room temperature of 20 degrees C. (68 degrees F.) or below without the production of chilling drafts; but that it is also important, on account of certain subtle but real effects of vitiated air upon appetite and inclination to work, to provide for an air change sufficient to avoid a heavy concentration of effluvia such as was associated in our experiments with a carbon dioxide content of 23 to 66 parts per 10,000.

Three important deductions, of vital interest to employers, result from this elaborate series of experiments in ventilation:

1. Overheating of workrooms wastes coal;
2. Lowers the working capacity;
3. Increases sickness.

It has already been distinctly proved that the prevailing cause of lost time is due to the respiratory diseases, of which the predominant malady is the "all too common cold."

METHODS OF VENTILATION

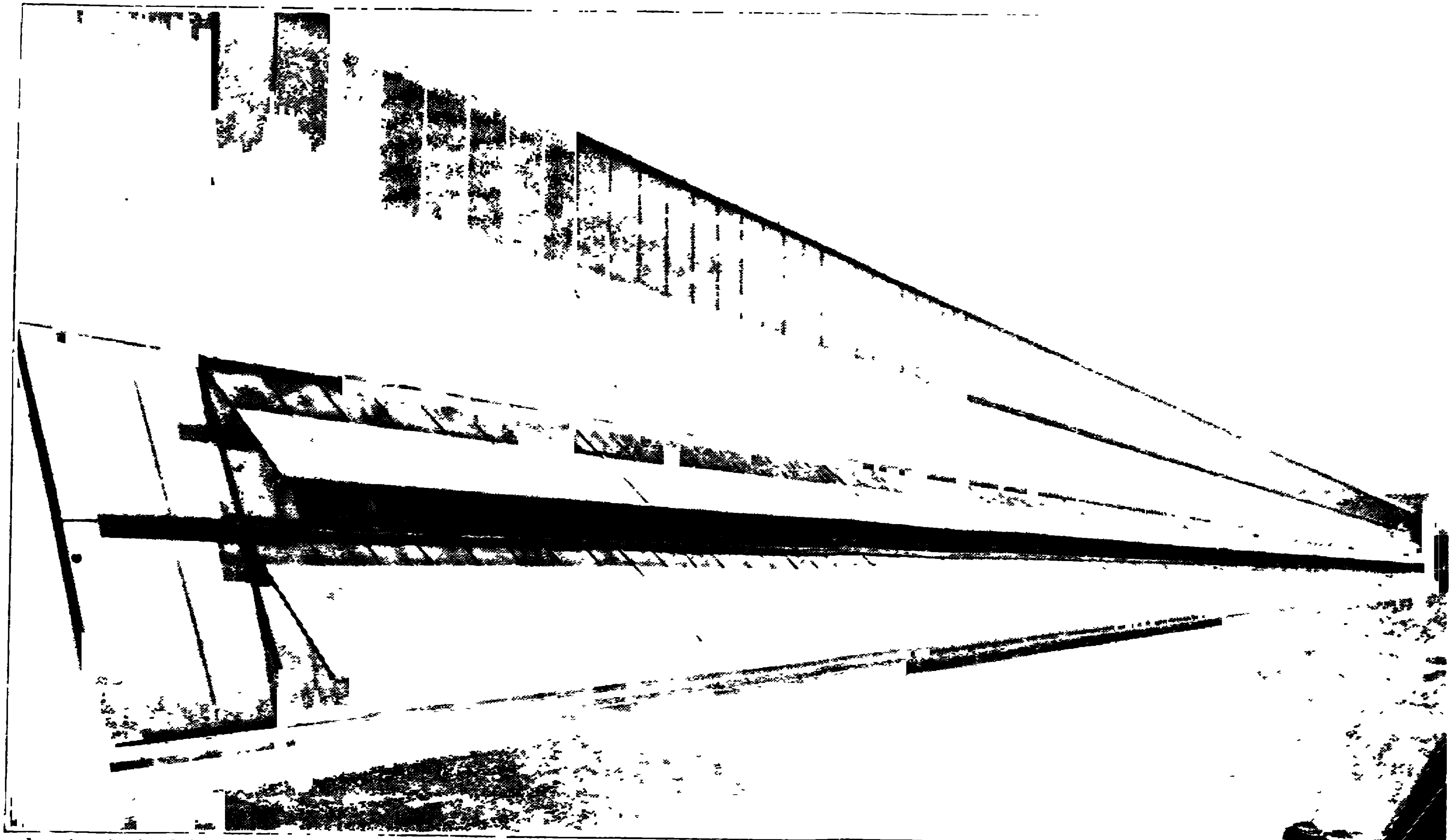
There are two methods of ventilation: structural and mechanical:

1. Structural
    - (*a*) Windows
    - (*b*) Doors
    - (*c*) Elevator shafts
    - (*d*) Stairwells and courts
    - (*e*) Special openings
    - (*f*) Cowls
    - (*g*) Roof vents

2. Mechanical
    - (*a*) Fans, for local ventilation
    - (*b*) Vacuum; exhaust by suction or extraction
    - (*c*) Plenum; air forced in by fans

The greatest crime against ventilation is the failure to provide sufficient window space. It is not enough to have ample windows, however, because unless they are manipulated intelligently proper ventilation may still be lacking. In old plants it was a common fault to have small windows; the window area should at least be 10% of the floor area and a very much higher percentage is now being commonly attained in all new buildings. In the Goodyear Tire & Rubber Company 66% of window space has been realized in buildings recently constructed. In other places as much as 85% of the wall space consists of glass. Large windows, besides reducing the building cost, provide light as well as ventilation. Pivoted sash gives better ventilation than either vertical or horizontal sliding windows but drafts cannot be so easily avoided as in sliding windows which may have deflectors placed at the top and bottom. High windows rather than low windows are more useful for getting rid of the foul and hot air which ascends, provided, of course, that they are opened at the top.

As an instance of modern use of natural ventilation the Studebaker Corporation has just erected a foundry at South Bend, Indiana. The atmospheric circulation created by the heating system is also promoted by continuous sash in the monitors and side walls. All of the sash in the foundry, cleaning room, and so forth, is electrically operated. Push buttons, located at nine stations on the floor, open and close entire runs of sash. The longest run, 600 feet, is in the material bay. By pressing one button sash may be opened, stopping automatically at the full. Another button stops the sash at any desired position, and a third button closes a given run of sash. A single row or all the windows of a run of sash may be operated at one time. Sixty-six motors



Iron Age, October 2, 1924

Figure 13. Electrically operated monitor sash

are required to control the windows. The push button stations are kept locked and are in charge of one employee who controls the ventilation of the entire foundry. There is one square foot of glass for every three square feet of floor space.[1]

Before embarking on any scheme of artificial ventilation it is wise to endeavor to use natural ventilation to the best advantage. There is much to be said in favor of natural ventilation if it can be used effectively. Much more attention has been devoted to the ventilation of schoolrooms than to offices or factory buildings. In schools, "the temperature of ventilated schoolrooms may be reduced as low as 59 degrees Fahrenheit, without increasing the prevalence of colds. . . . Window ventilation competed favorably from a hygienic and esthetic standpoint, with the most elaborate and costly fan and duct equipment."[2]

MECHANICAL VENTILATION

All mechanical ventilation depends on fans which are used to circulate air locally, force it in or draw it out. Local fans effectively eliminate stagnation in small areas and thus secure a measure of comfort for office workers. They are uncommon in the workroom though quite desirable, and factory workers have been known to solve the problem themselves by attaching improvised blades to revolving spindles; the idea could be extended with advantage.

In plants where there is much fume and dust the impure air must be sucked out. The essentials of localized exhaust ventilation are a duct along which the flow of air is maintained in a definite direction and localized openings in the ducts through which sufficient air is admitted to allow the flow of air to be maintained.

---

[1] Lacher, Gilbert L. "Studebaker Gray Iron Foundry Largest," *Iron Age,* October 2, 1924, p. 842.

[2] Palmer, G. T. *Journal of Laboratoy and Clinical Medicine,* October, 1921.

> The great essential is to maintain a satisfactory balance between the air drawn from the room and the fresh air drawn in. If the ingress openings be some three times the area of the egress openings; if they be uniformly distributed, and the air admitted be drawn over steam coils; the problem of a draftless ventilation during the winter months should be solved to the satisfaction as well as the physical comfort of the worker.[1]

Exhausting the air by suction from the room induces the entry of outside, and presumably fresh, air. This air may be heated, dried, cooled, moistened, filtered, and controlled at will, and some of these conditions are necessitated in certain cases. Usually, however, exhaust air is replaced by more or less pure air which enters windows, doors, vents, cracks in the floor, and the like. Where workers are engaged in grinding, manipulating poisons, or in generating heat, the exhaust is local and each machine is provided with a suction duct which carries off the objectionable matter. Care must be taken to fit the hoods surrounding the operation so that the suction will be sufficient to prevent dust from escaping into the room. In the use of local exhaust systems no special means of supplying fresh air are used. It is obvious that, unless the air sources are pure, there will hardly be good ventilation.

In the construction of ventilation ducts an interesting experiment was made by Winslow and Greenburg to ascertain the relative merits of various designs, and the following conclusions were reached:

> 1. Branch ducts give better results than lateral ports.
> 2. With either branch ducts or lateral ports, an untapered main duct gives better results than a tapered one.
> 3. Other conditions being equal, plenum ventilation is more even than exhaust ventilation.[2]

It was also shown that slanting branch ducts gave an even distribution of air and that reasonably good distribution can be economically effected with an untapered duct discharging or exhausting through lateral ports.

---

[1] Erskine, Lillian. "Standardization of Working Essentials," *Annals of the Academy of Political and Social Science*, May, 1917, p 84

[2] Winslow, C.-E. A., and Greenburg, Leonard "Efficiency of Various Kinds of Ventilating Ducts," *Public Health Report*, July 28, 1922

The Bureau of Hygiene and Sanitation of the Department of Labor of the State of New Jersey has issued the following:

STANDARD SPECIFICATIONS FOR THE CONSTRUCTION AND INSTALLATION OF EXHAUST SYSTEMS FOR THE REMOVAL OF INDUSTRIAL DUST, NOXIOUS FUMES, EXCESSIVE HEAT, AND HUMIDITY [1]

1. *Material:* Galvanized sheet steel or iron, unless otherwise specified, shall be used in the construction of all systems.

2. *Gages of Material:*

Table 1

Diameter of Pipe	Gage
8 inches or less	24
9 inches to 16 inches	22
17 inches to 24 inches	20
25 inches to 30 inches	18
31 inches up	16

Table 2

Diameter of Pipe	Gage
8 inches or less	22
9 inches to 16 inches	20
17 inches to 24 inches	18
25 inches up	16

All elbows two (2) gages heavier than the pipe to which they are attached.

3. *Riveting:* All straight seams shall be riveted with tinned rivets placed on not more than three-inch centers.

All round seams shall be riveted as follows:

Diameter of Pipe	
4 inches to 8 inches	4 rivets
9 inches to 12 inches	5 rivets
13 inches to 18 inches	6 rivets
19 inches to 24 inches	7 rivets
25 inches and larger	9-inch centers

Where straight seams are made by means of a "groove or lock seam" riveting will not be necessary.

4. *Soldering:* All seams shall be soldered air tight and edges coated.

---

[1] *Sanitary and Engineering Industrial Standards,* New Jersey State Department of Labor, Trenton, New Jersey.

5. *Laps:* All piping, and so forth, shall have at least a one-inch lap placed in the direction of the flow of air.

6. *Elbows:* All elbows shall be made on a radius in the throat of not less than 1½ times the diameter of the elbow. No internal crimped edges shall be used.

7. *Collars:* All pipe collars shall enter the main pipes at an angle of 45 degrees and shall be riveted and soldered to the main pipe.

8. *Blast Gate:* Every branch pipe shall be fitted with a malleable iron blast gate with a slide attached to the gate.

9. *Telescopic Slip Joints:* All telescopic slip joints shall be made with a wire edge or band iron. Slip should be two gages heavier than the outside pipe, and provided with a fastener to hold same in position.

10. *Fan Inlet Connection:* At the point where the piping connects with the suction side of the exhaust fan, there shall be a detachable sleeve.

11. *Automatic Fire Dampers:* Wherever piping passes through a wall or floor or from one building to another, an automatic fire damper shall be placed in the wall with blade of damper pointed toward the line of suction, and shall be so hung on a fusible link that in case of fire the damper will drop into position and close the pipe.

12. *Dust Separators:* All exhaust fans handling dust or waste material shall discharge into a dust separator which will separate the dust or material from the air.

While it is not practicable to specify any particular dust separator, it is necessary to warn against installing a separator of too small a proportion, as the resistance on the fan not only greatly increases the amount of horse-power required, but also reduces the suction that should be obtained.

13. *Supports:* Separators shall be set in structural steel frames and all piping suspended or supported with iron braces. All piping shall be braced and supported at least every 10 feet.

14. *Plans:* Plans in duplicate showing general details of construction, together with a statement of the kind of work the system is designed for, shall be filed with the Bureau of Hygiene and Sanitation for approval before the work of installation is commenced as provided for by Chapter 17, Laws of 1918—and a fee submitted in accordance with the following:

The Commissioner of Labor is hereby authorized to charge a fee of not less than $1 nor more than $5 for the issuance of a certificate of approval of any plans or specifications required by any law or regulation of the Department of Labor of this State to be submitted to him for his approval. Said Commissioner shall also be authorized to charge a fee of not less than $1 nor more than $5 for the issuance of any certificate of approval of any factory building or of any alteration or new work performed therein, upon the recommendation of said Commissioner Said Commissioner shall be governed in fixing the fees above mentioned by the amount of trouble and expense involved in the examination of said plans, specifications, or work.

The Commissioner of Labor is hereby authorized to charge a reasonable fee for blue-prints, literature, and publications issued by the Department of Labor The moneys paid to the Commissioner of Labor under this act shall be paid by him to the Treasurer of the State of New Jersey.

APPARATUS FOR REMOVAL OR CONTROL OF DUST, FUMES, OR HUMIDITY:

Costing from $100 to $500	$1
Costing from $501 to $1 000	2
Costing over $1,000	3

NOTE: This is also to cover inspection of installations where plans were not submitted.

In the so-called plenum system air is driven into the rooms and so dilutes and mixes presumably fresh with interior air. Comparatively pure air may be obtained by ducting from a source 20 or 30 feet above ground. This air may be warmed or cooled as needed. The system is apt to be drafty, but where the air is to be conditioned it is under complete control. Care must be taken, whatever method is used, to draw impure air away from the worker or force pure air towards the worker. The mistake of placing fans in the wrong position is often made and, sometimes, after a ventilation system has been designed, the position of the machines is altered and the value of the system destroyed. A modification of the plenum system is to have a fan at each window blowing air through specially designed window radiators.

The success of any system of ventilation, either natural or artificial, depends on intelligent operation. No system will operate itself and the most complete plan may be ineffective unless properly controlled. Some one person who understands the principles of ventilation should be in charge and this applies equally to places where there is no mechanical ventilation system. Windows should be open or shut, not according to the whims of the individual, but according to general requirements. All rooms, as a matter of ordinary routine, should be fully ventilated before and after work and particularly during the lunch hour. Even in plants where no one has charge of general ventilation it is quite possible to assign the duty of ventilating each room to some one individual. It is a common occurrence to have workers enter rooms in the morning which have been closed tight from the time they left work the night before. In the Harvard School of Public Health courses are given on industrial hygiene of which ventilation forms a part. Industrial doctors who have had the advantage of such a course are competent to deal with the subject as far as the maintenance of the workers' health is concerned.

Of the advantage of paying attention to ventilation there can be no doubt. It is not easy, however, to establish figures showing the direct benefits of good ventilation on health. Ample proof has been forthcoming in the last few years to show that ventilation has a direct effect on output so that an employer who improves ventilation probably secures better health for the workers while positively increasing the output. The British Industrial Fatigue Research Board has made extensive tests in a number of industries, such as linen weaving, laundry work, and cotton weaving. The latter report is based on an extensive series of observations of the temperature, cooling power, and movement of air. It was ascertained by one study that a 12% increase in output might be expected in the South Wales tin-plate industry by a more efficient system of ventilation. The United States Pension Bureau reduced the absence of its employees from 18,736 to 10,114 days by moving into new well-ventilated quarters. The New York State Ventilation Commission ascertained that the inclination to do physical work and the inclination to do mental work are diminished by high temperature:

So far as physical work is concerned our tests show a decrease in actual work performed, when the subject has a choice between working or not working, of 15% under the 75-degree condition and of 37% under the 86-degree condition as compared with 68 degrees in each case.

In view of the fact that respiratory diseases prevail in industry it is interesting to note the results obtained by the Bureau of Child Hygiene in cooperation with the State Commission of Ventilation in New York. With 5,533 pupils, 76 schoolrooms, and 12 schools, the following facts were shown:

TABLE 71

RATIO OF RESPIRATORY DISEASES AND ABSENCE FROM RESPIRATORY DISEASES ACCORDING TO METHOD OF VENTILATION AND TEMPERATURE OF ROOM IN NEW YORK SCHOOLS

Method of Ventilation	Condition of Windows	Temperature of Room (Degrees F.)	Ratio of Absence from Respiratory Diseases	Ratio of Respiratory Diseases
Natural	Open	60	100	100
Natural	Open	68	140	170
Mechanical	Closed	68	132	198

XVIII

HEAT AND HEATING

Heat and production. Sources of heat. How to keep cool Protection from heat and cold Plant heating Air, steam, and hot water contrasted Regulation of plant heating. Cooling air in summer Dangers of salamanders.

EXTREMES of heat or cold lessen production and are a serious detriment to health. Hence, the regulation of temperature is a subject of interest to the plant manager no less than to the doctor. That this is not so commonly achieved as supposed is made clear by an investigation of a large number of workrooms made by Leonard Greenberg, of the United States Public Health Service. Sixty-eight per cent of the rooms investigated were at a temperature of more than 70 degrees, and 15% were at 75 degrees and over.[1] Man is adaptable to temperature changes only within certain limits. The body normally gives off heat after it has acquired heat-giving substances; too rapid cooling results in chill, and too much heat results in heat-stroke. When a portion of the body is chilled, as in a draft, the blood fails to circulate normally in the chilled part, a diseased condition arises locally, microbes propagate, and we have a condition which is popularly known as a "cold." On the other hand, if there is no perspiration in hot weather the body not only fails to cool but, in accordance with physical laws, the temperature rises with the surrounding heat and heat-stroke results.

Such conditions militate against full production—heat, perhaps, more than cold. In merely cold weather a worker by activity can somewhat offset the numbing effects of cold, but there is no relief beyond a certain point in hot weather except by ceasing work. It is common knowledge that production tends to fall off in hot weather and it is even said that, "the rate of production in the iron and steel trade in July is 2½% less than in June owing to the hot weather." That this is not altogether strange may be judged by the following quotation:

---

[1] *Industrial Ventilation*, Baltimore Safety Council Conference, January 23, 1925.

> One who has never tried it can little realize how desperate some of the work in the heat is heat so intense that the skin would burn instantly were it not wet with sweat; heat where I have seen a dry handkerchief tied across my face go up in a blaze; heat where one must stand his ground even when he smells his sweat-wet trousers scorching. . . . Hot work is desperate work oftentimes. It wears and frazzles out the best of men.[1]

Apart from atmospheric conditions there are many sources of heat in industry. The temperature of air, under ordinary conditions, depends on solar or terrestrial radiation, but in manufacturing are found not only heat- but cold-generating processes. Paper mills, sugar refineries, flax mills, laundries, tanneries, kitchens, stoke holes, fire rooms, glass factories, steel mills, blast furnaces all generate huge amounts of heat, some dry, some humid. In refrigerating, cold storage, slaughtering, and in certain phases of benzol manufacturing, cold is the prevailing condition.

The human body is sensitive to such variations. Its normal temperature is 98.6 degrees F., which is the balance it maintains between heat production and heat loss, a variation from which of even a few degrees produces profound discomfort. The food consumed provides much of the fuel; the amount of the heat produced depends on the intensity of the work. Heat is lost by direct conduction by contact with a cooler medium; by direct radiation to a cooler distant surface; and by evaporation from skin surfaces.

Direct conduction depends on temperature, velocity of air movement, and on thermal capacity and conductivity, the latter depending on density, humidity, and temperature of the air. Evaporation takes place from lung and skin surface and, in the latter case, the temperature, combined with the air movement, is of primary importance. A brisk wind may reduce the temperature as much as 15 degrees.

---

[1] Perley, Alden "Mill Work," *Iron Age*, March 1, 1923 p 615

In each extreme of temperature there are decisive premonitory signs of approaching bodily damage. Heatstroke is entirely due to suppression of perspiration, with the consequent accumulation of excessive heat in the body, and the remedy is, of course, restoration of normal conditions without delay. In the case of frostbite, which is really failure of the blood to circulate in the exposed part, there is blanching of the skin. Such extremes are comparatively rare in industry. What must be provided against in the workshop are the minor conditions which, in the aggregate, affect production more seriously.

There are many small ways whereby the effects of heat may be reduced. The Health Commissioner of New York, for instance, offers the following advice in hot weather:

HOW BEST TO KEEP COOL

Clothing and Exercise:
- Dress lightly and as cool as possible
- Avoid physical exercise as far as possible
- Keep out of the sun

Food and Drink:
- Drink plenty of cool water, avoid iced water
- Avoid sweet drinks, alcohol, tea, or coffee in excess
- Eat sparingly—of fish, fruits and vegetables, cereals, clean milk and buttermilk
- Avoid rich foods, fats, sweets; meat no more than once a day

Bathing and Medicine:
- Wash and bathe in cool water at least twice a day—take salt water baths in ocean if possible
- Take no medicine except on advice of physician

Needless to say such advice must be modified according to industrial requirements. The worker should be cautioned, for instance, to avoid *unnecessary* physical exercise. It would be foolish, also, to caution the employee to drink plenty of cool water without providing a good supply in the shop, or to recommend people not to drink iced water and supply it alone at the same time. Should the employer house his workers he should see that they are provided with baths and a proper water supply. These reflections are prompted by a recent case in which the employer recommended bathing to his workers without reverting to the fact that his "company houses" had neither bathtubs nor a water supply.

Cold rooms cause men to put on too much clothing, which hampers them in their work. Cold lowers resistance to disease; it drives the blood from the surface of the body and causes internal congestion. Excessive clothing causes perspiration and the reaction renders men liable to chill when work ceases.

Workers can be protected from heat by a variety of devices, of which proper manipulation of windows is the chief. In furnace work, hats, asbestos aprons, and leggings may be used. Screens of heavy chains may be hung in front of furnace doors or the doors may be water-cooled. Vents underneath or at the side of the furnace doors force air across the opening; or ducts, placed above the furnace, force cool air down upon the worker, or between him and the source of heat. None but the strongest men should be chosen for furnace work, a factor provided for by competent physical examination. Men in ordinary good health, with digestion and elimination properly functioning, are not readily affected by heat. Iced water in hot work is dangerous and causes cramps. The water should be cool but not cold, and small amounts of unsweetened lemon juice make it palatable. Hot drinks taken in summer ultimately cool the body more substantially than iced drinks by temporarily relieving the heart from work. Reduction of hours in arduous occupations and mechanical changes are sometimes possible in decreasing the possibility of heat exhaustion.

PLANT HEATING

In order to secure maximum efficiency from workers, attention must be paid to the maintenance of a suitable temperature in the place of work. Effective systems of heating must be founded on a knowledge of outside temperatures and consideration of the heat generated in plant operation. "The commonest evil in air conditioning in factories is the slight but highly objectionable overheating. . . . This evil can be overcome by regulation of the artificial heat supply and the use of windows before and during the shifts." Excess of heat, besides wasting money, reduces the working capacity.

Illustrative of present conditions is a recently published study of management practice in 54 foundries by the Policyholders' Service Bureau of the Metropolitan Life Insurance Company, wherein the following facts were ascertained:

TABLE 72

HEATING SYSTEMS IN 54 FOUNDRIES

Source of Heat	Number	Percentage
Air conditioning	5	9.2
Hot air	18	33.3
Stoves	7	13.0
Steam	2	3.7
Hot water	1	1.8
No special heating arrangement	21	39.0

The normal desirable temperature varies with the occupation and should be 50 to 55 degrees, Fahrenheit, in foundries, 60 to 65 degrees in machine and woodworking plants, and 60 to 72 degrees in textile, shoe, and clothing plants. The law provides for the regulation of temperature in schools, theaters, churches, but it is not as rigorously enforced in factories., However, where materials may deteriorate from changes in temperature, means are found to provide the proper degree of heat. In some instances steam heat is used to keep ordinary sand from freezing, but no such careful provision has been made for the worker's comfort.

In heating plants three alternatives may be considered: steam, hot water, and heated air. In the use of steam the gravity return system is by far the cheapest, but the vacuum return system may have to be installed if gravity return is impossible; this latter arrangement necessitates the use of expensive appliances requiring care, maintenance, and the frequent manipulation of valves.

Low pressure steam heating is suitable for small plants. High pressure steam is wasteful but may be used if waste heat is available. If power is generated on the premises, steam is preferable to hot water because the temperature is under better control either by thermostat, hand valves, or windows. Thermostats, however, are expensive, although they may reduce the cost of fuel about 10%. Valve control is often difficult to obtain and, while opening windows decreases temperature it increases cost through waste. The first cost of steam is less. It is suitable for small plants, in mild climates, for those in operation eight hours a day, or where there is no danger of freezing of sprinklers, chemicals, or liquids. Its disadvantages are the difficulty of regulation, the excessive drying of the air, and recurrent overheating.

The gravity or forced circulation hot water heating is most suitable where an even and constant heat is desired, such as in plants with sprinkler systems. The hot water is circulated through a system of flow and return mains by means of a centrifugal pump, and exhaust steam is sometimes used for heating the water. Hot water probably costs less than steam in large plants and is more flexible since it can be run up or down. It is specially adapted for groups of scattered buildings of moderate height from a central station. It is easily the best system for using exhaust steam or waste heat of any kind. There is central control of heat; the installation and operation are simple, and there is economy of heat and longer life of equipment.

From the point of view of the plant physician hot water heat is preferable to steam since the temperature is more even and the air not too dry.

The heated air system consists of an air duct which brings in or should bring in uncontaminated air through a series of steam coils by the use of an electrically driven fan and when the air is heated it is distributed to the workrooms through galvanized piping. In large plants it is necessary to have fans and blowers at various isolated points. Each fan must have its own operating unit, which needs constant attention. "From the point of view of operation, as distinct from installation, the blower system is not to be compared with either the steam or hot water system, and with automatic temperature regulation the cost is much increased. However, the system can be used in warm weather for introducing cold outside air into workrooms by the mere shutting off of steam from the coils and operating the fans alone; this is done far too infrequently.

The United Shoe Machinery Company uses its air heating system for cooling the shops in summer, which is a desirable practice in any plant where the temperature rises to a point beyond that of maximum working efficiency. In the Tata plant of the Tin Plate Company of India where, on occasions, the outside temperature rises to as much as 110 degrees Fahrenheit in the shade, there is a blower and air washer. The blower delivers 9 cubic feet of air per minute per square foot of operating surface, or over 400 cubic feet of air per man per minute. By using the air washer it was found possible to reduce the average outside air temperature of 104 to 87.1 degrees Fahrenheit.[1]

Salamanders are sometimes used for heating new buildings to dry out newly plastered walls or in places where no other provision has been made to maintain a working temperature. The salamander is a movable metal container for burning coke, coal, or charcoal. It is usually a vertical cylinder with holes in the sides or sometimes it is made of v-shaped grating. As a ready means of obtaining heat it is useful, but it is dangerous on account of the large amount of carbonic oxide generated. When used it should be piped to outside air and no salamander should be used without the proper authorization of the superintendent or foreman in charge who should be aware of the danger of poisoning.

---

[1] Estep, F. L. "The Manufacture of Tin Plate in India," *Iron Age*, October 30, 1924, p. 1122.

XIX

PLANT LIGHTING

Importance State provisions Causes of bad lighting Sources of light, essentials of good lighting Lighting code Natural lighting Relation to windows Artificial lighting. Determination and measurement Relation to production

ADEQUATE plant lighting is, perhaps, more important for the employer than the worker. Where the light is insufficient the former loses production in many different small ways while the latter seeks to protect his sight by going slow or using his eyes to a less extent than the quality of the work demands, from which spoilage is bound to result. The vital importance of good lighting has recently gained substantial recognition and many employers have improved or are about to improve their lighting. In an investigation recently made by a prominent lighting company it was found that over 30% of several hundred industrial plants had not changed their lighting system in the last five years, yet in that short span considerable advances have been made in plant lighting. Where changes are being considered the tendency seems to be to exceed the generally recognized minimum requirements by a generous margin.

Seven states—California, Pennsylvania, Oregon, New York, Wisconsin, New Jersey, and Massachusetts—have sought, within the last few years, to secure good lighting in industrial plants by issuing regulations and lighting codes, the facts indicating that, on the whole, lighting is still capable of much improvement. Few of the older plants have found it possible to keep pace with modern standards of illumination and it still seems true that no more than half the plants of the country are sufficiently illuminated according to present ideas.

Good lighting brings substantial advantages; it increases production, decreases spoilage, lessens accidents, helps discipline, promotes content, and reduces eye-strain. Of itself lighting is only an indirect aid in plant management. It will not increase production alone, but it will provide one of the essentials for the worker who wants to maintain speed and yet avoid breakage and waste. Good lighting helps the worker to turn out more work with less effort and to avoid possible causes of accident.

The causes of bad light are not only insufficiency, although that is the main defect. In some cases the supply of light is ample, but it is neither placed nor used properly; there is glare either from unshaded lamps or from reflecting surfaces. In others, there are extreme contrasts of light and shade and lack of proper distribution.

The employer has two sources of light: natural and artificial. Natural is altogether preferable to artificial light. Only new plants are designed to avail of natural light to the full by the provision of ample window space and proper placement of working apparatus in relation thereto. Modern requirements demand sufficient light for each worker, and the location, area, and spacing of windows so that daylight conditions are uniform over the working area, necessitating the use of artificial light as little as possible. Direct sunlight should be avoided either by placing work benches outside its rays or by providing shades or frosted glass on the windows. Ceilings and walls should be of light color to reflect window light, but the lower portion of walls should have a darker shade to rest the eye.

ESSENTIALS OF GOOD LIGHT

Good light must be adequate, continuous, and diffused. There must be sufficient window space in the daytime and adequate light at night, there being just as much occasion to prevent direct sunlight from blinding workers as there is to provide a sufficiency. The supply of light must be uniform and continuous, and there should be no flickering or abrupt changes in intensity. Diffusion should be accomplished by a distribution of the sources of light—the distance between units being never greater than twice their height—and, also, by means of light-colored, non-shining walls, and ceilings with flatted surface. Whitewashed walls in a steel mill, for instance, provide a flatted surface which adds considerably to the diffusion of light.

LIGHTING CODES

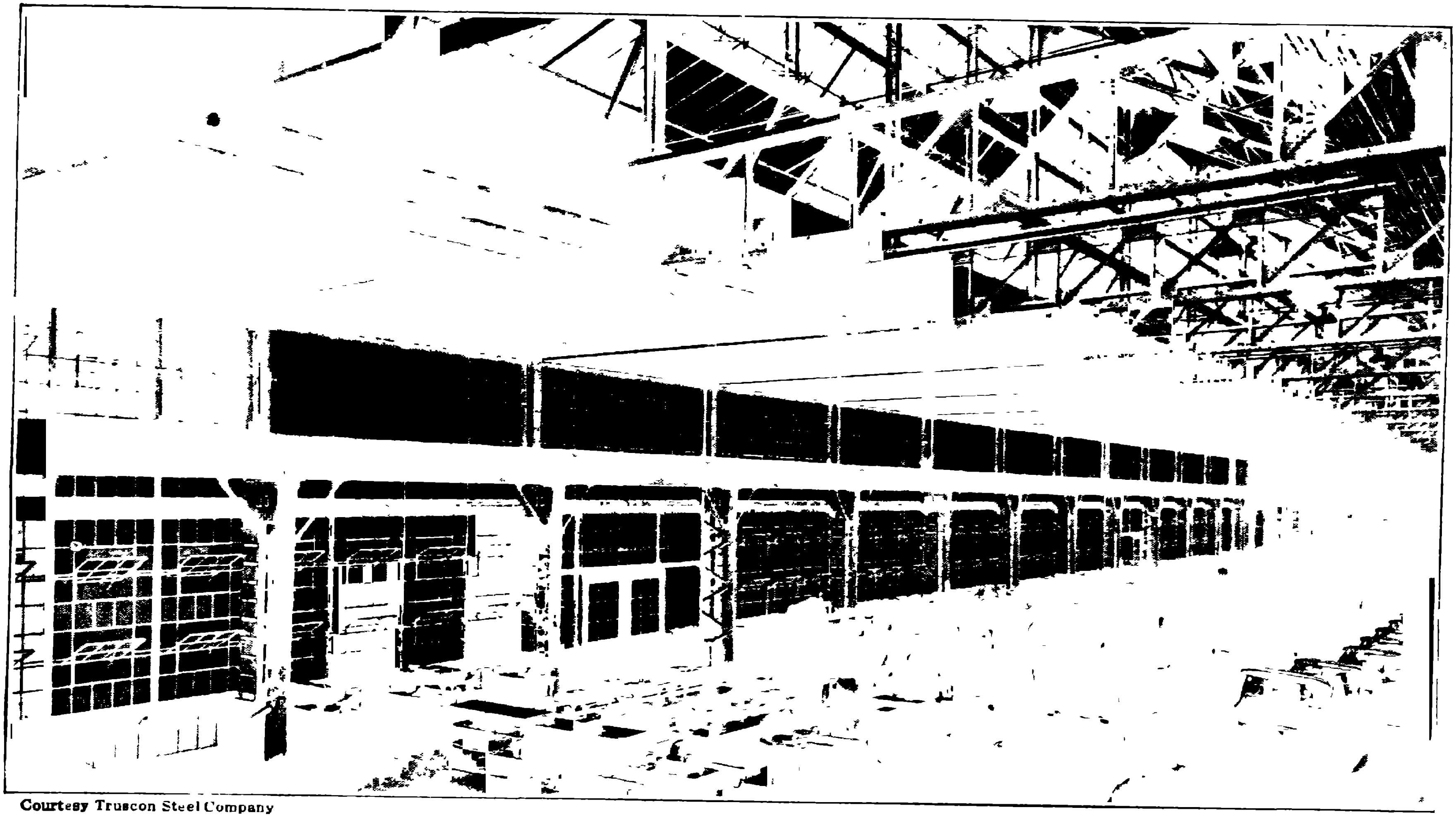
Several states have adopted lighting codes in order to secure adequate light. These codes specify the minimum lighting requirements for certain classes of work. The code issued by the American Engineering Standards Committee provides for the minimum foot-candles of light given in Table 73.

These requirements are the minimum allowable, and it is necessary to provide for a much higher amount in order to be able to maintain the minimum at all times. Those selling lamps, lighting apparatus, and power recommend provision for three times as much as the minimum requirements.

Natural lighting is always preferable on account of health and economy. M. Luckeish, of the General Electric Company, however, states that, "in nearly all cases natural lighting cost more than artificial lighting,"[1] but the argument is somewhat labored. Natural lighting may be secured by the full utilization of windows or from the roof by means of saw-tooth construction whereby diffused light from the sky reaches the work during the day; or from horizontal or nearly horizontal skylights. Prismatic glass deflects light into the working spaces which do not obtain direct rays. The character and cleanliness of the glass used may affect the efficiency of natural light considerably. Wire glass may be used instead of clear glass to meet insurance

---

[1] Luckeish, M. *Light and Work.* D. Van Nostrand Company, New York, 1924.



Courtesy Truscon Steel Company

Figure 14. Interior view of the Ford Motor Company, River Rouge Plant, showing the use of steel sashes throughout

TABLE 73

MINIMUM ALLOWABLE FOOT-CANDLES OF LIGHT INTENSITY ON THE SPACE OR AT THE WORK

Particulars	Foot-Candles
1. Roadways; yard thoroughfares	0.02
2. Storage spaces: aisles and passageways in workroom, except exits and passages leading thereto	0.25
3. Where discrimination of detail is not essential.... (Spaces, such as: hallways, stairs, exits and passages leading thereto; toilet-rooms; elevator cars and landings) (Work, such as: handling coarse materials; grinding clay products; rough sorting; coal and ash handling; foundry charging)	0.50
4. Where slight discrimination of detail is essential... (Spaces, such as: stairways, passageways and other locations where there are exposed moving machines, hot pipes, or live electrical parts) (Work, such as: rough machining, rough assembling; rough bench work; rough forging; grain milling)	1.00
5. Where moderate discrimination of detail is essential (Work, such as: machining; assembly work; bench work; fine core making in foundries; cigaret rolling)	2.00
6. Where close discrimination of detail is essential... (Work, such as: fine lathe work; pattern making; tool making; weaving light-colored silk or woolen textiles; office work; accounting; typewriting)	3.00
7. Where discrimination of minute detail is essential (Work, such as: watchmaking; engraving; drafting; sewing dark colored material)	5.00

requirements and, when horizontally ribbed, gives better diffusion than plain glass though it is more difficult to clean.

Direct sunshine is unsuitable for work and hence vertical windows should have either shades or frosted glass. In the case of saw-tooth construction, windows should face the north in order to obtain diffused light rather than direct sunlight. Shades may cover the whole window or only part.

They may operate from the bottom of the window upwards or the reverse; in some cases they cover only the middle of the window so as not to bar the light from the middle of the room. In all cases shades should be of light color. Benches, as a rule, should be run at right angles to the window areas.

ARTIFICIAL LIGHTING

There are three methods of lighting plants artificially; local, general, and a combination of the two, the conditions of work determining which is the most suitable. Where there has to be a considerable number of local lighting units for fine work there is little need for general illumination. In coarse work general illumination is sufficient. Large lighting units, hanging high up near the ceiling, give an even distribution of light on coarse work. This method may be used to give more intense light at some points than others by spacing so as to give the advantage of both local and general lighting. Where specially fine work is done local lights may be supplied in addition to the general lighting. Care should be taken not to use local for general lighting if it involves the exposure of naked lights.

The essentials of artificial lighting are that it should be readily available at low cost, that it should resemble daylight as far as possible, that it should be of moderate intensity and illuminate a sufficient area. Light may be direct, semidirect, or indirect. Direct lighting is cheaper but more intense and is generally more suitable for individual work than indirect light. The latter is more agreeable and less trying to the eyes but costs about three times as much. Shades should deflect light to the work and not to the worker. Reflectors serve to diffuse and intensify light, provided they are kept clean. Although their value is undoubted in providing satisfactory light they are not as yet by any means universally used. Absence of light shades permits glare which may be also due to too great intensity, too much brightness, location in field of vision, too great contrasts, too continued exposure, or too much reflection. Glare destroys the benefits of good light by contracting the pupil and on the whole is less desirable than indifferent light without glare.

Every light should be shaded so that no part of the filament or other light-source is visible. It is a crime against health and economy to provide glaring lights. General lighting should be well above the line of vision and local lighting should be well shaded. Good general lighting serves to prevent contrasts. Shining walls reflect the light of each unit and hence cause glare. Flatted surfaces tend to diffuse light. White walls reflect about 80% of the light and are of considerable value in securing diffusion. The practice of painting machines a light color is an added way of securing more light. Dark colors reflect correspondingly less light and should be avoided in work places.

LIGHT DETERMINATION AND MEASUREMENT

In estimating the amount of light in a given place the foot-candle is the unit of measurement. A foot-candle is the illumination received on a surface placed normally (at right angles) at a distance of a foot from the source of light having a luminous intensity of one candle. The foot-candle meter is used to measure the amount of light by being placed at working distance from the source of light to be measured.

The essentials in determining the suitability of a given system of lighting depend on the location and structure of the building, relation to dust and dirt, window exposure, ceiling height, placement of windows, color of walls and reflection factors, color of ceiling and reflection, reflection factor of floors, and, specifically, the nature of the work.[1]

Provision of adequate artificial lighting is not sufficient to ensure the success of a lighting plan. Arrangements must be made for the maintenance of the scheme. There is a great loss of light from dirty reflectors and bulbs as well as from dirty windows and walls. While most plants have placed responsibility for the maintenance of lighting fixtures and bulbs, it is sometimes found that no specific arrangements have been made to clean the equipment. The result is that dirt and dust accumulate on the lamps and reflectors which give, in consequence, much less than the possible amount of light. Lighting deterioration is also due to wearing out of bulbs, to broken and burned-out units, and to cracked, muffed, and broken reflectors. "In one large plant a regularly developed method of inspection and renewals is employed. As an example the method as applied to several thousand tungsten lamps which are in service in the various buildings will be described. All the lamps are inspected once per day, except Saturday and Sunday. A regular route is followed by the inspector, and all burned-out lamps, broken switches, loose fuses, and similar items are noted. Careful observation is also made of reflectors which appear to need washing and any other points which might affect the efficiency of the system, after which a report is made up about noon and promptly sent to the maintenance department to permit all renewals and repairs to be made before night." [1]

---

[1] *Transactions of the Illuminating Engineering Society*, July, 1924; Symposium

Many claims have been made to indicate the advantages to be obtained in production from good lighting. It is, however, exceedingly hard to isolate the value of lighting as compared with other factors. In *Report Number 9* of the Fatigue Research Board it is claimed that production in the silk industry increased steadily as the days lengthened, from which it is inferred that light was the cause. It may be equally true that mere increase of experience had also something to do with the increase. It is a well-known fact that continued performance of work alone makes increased production possible for months and even years.

---

[1] "Code of Lighting for Factories, Mills, and Other Work Places," *Reprint Number 499, Public Health Reports*, January 24, 1919.

In operations making special demands on the sight the advantage of good light is obvious and doubtless leads to substantial increase in production. In tests made on the inspection of over seven million roller-bearing parts increased production was shown to vary with illumination intensity as follows:

TABLE 74

EFFECT OF ILLUMINATION ON PRODUCTION [1]

Foot-Candles	Percentage Increase in Production
20.0	12.5
13.0	8.0
6.0	4.0
5.0	0.0

In one large firm a three years' test of lighting was carried out and careful records taken in order to compare the efficiency of lights in terms of output. When the experiment began, the intensity of light was 1.2 foot-candles, and the factory was lighted by lamps suspended from drop cords. The first change was to replace them by 100-watt lamps with overhead reflectors, giving 6½ foot-candles intensity. With this alteration an increase of 13% in production was obtained. This improvement encouraged a still further increase, and 150-watt lamps were put in, giving 9 foot-candles. This step led to an increase in production of 17.9%. Similarly, 200-watt lamps with overhead reflectors were installed, giving 14 foot-candles, and the result was an increase of 25.8% production over the original installation.

The manufacturer whose lighting is not up to modern standards can hardly afford not to increase his illumination since the relative cost of labor and light is in such a wide ratio. A worker may get $5 or $6 a day in wages while the difference in cost between good and bad lighting can hardly amount to more than 1% of the wages per day.

In England, according to a note in the *Nation's Health* for September, 1924, a report by W. E. Bush in *Engineering Production* for May, 1924, shows the results following improvement in lighting in nine different factories, as follows:

---

[1] Hess, D. P., and Harrison, W. "The Relation of Illumination to Production," *Transactions of the Illuminating Engineering Society*, November, 1923, p. 787.

TABLE 75

RESULTS FOLLOWING IMPROVEMENT IN LIGHTING IN NINE FACTORIES

Average illumination	
Before improvement	2.3 foot-candles
After improvement	11.2 foot-candles
Cost of improvement	
Percentage daily pay-roll	1.9%
Increased production	15.5%

At the Acheson Harden Company's plant in Passaic, New Jersey, the following results were obtained:

> Starting with an original illumination of 2.14 foot-candles, refinishing the walls and ceilings increased this value to 2.68 foot-candles, representing an improvement of 25%. By thoroughly cleaning the lamps and reflectors the illumination was raised to 3.61 foot-candles. This was an additional increase of 35%, or, in other words, an improvement of 68% over original conditions.[1]

In determining upon the light to be supplied to the workers it is desirable to consider two points not often taken into account: the worker's opinion of the light he needs, and the relation of eyesight to lighting requirements. The prevalence of defective eyesight has already been indicated and when lighting is being supplied the fact should be borne in mind. Another point, generally neglected, is that specific responsibility for the whole problem should be placed in the hands of some one who understands the technical as well as the human aspects of the case.

---

[1] Atwater, D. W "Sixty-eight Per Cent More Light from the Same Equipment," *Factory*, November, 1924.

XX

FOOD AND LUNCH ROOMS

Food and output. Factors in providing lunch rooms Determining the need. Methods: lunch room, cafeteria, buffet, lunch wagon. Extent of usage. Lunch room. Layout Size and seating capacity. Attendance. Equipment Management The cafeteria system. Cost of supplying food. Method of payment. Advantages

THE advisability of supplying meals to workers has received such substantial recognition in the last few years that no argument need be advanced why employers should have lunch rooms. The factory system created the lunch room problem but it took many years before its solution obtained general acceptance. Yet, the need has been recognized as early as 1812. "Such as reside in cottages not too remote from the factory, eat their meals at home; such as reside at greater distances form messes and cook their own food in the mess rooms, fuel and culinary apparatus being gratuitously supplied for that purpose . . . the milk is supplied by the farm attached to the factory." [1] We are now at the stage of discussing methods rather than enquiring whether lunch should be provided.

Satisfactory production, among other things, depends on quality and quantity of food. When the employer supplies the diet he is reasonably sure of these important factors. Workers are ignorant of food values, though not of the cost of food. When there was no lunch room a worker brought his own dinner pail, had it sent to him at the lunch hour, or went out and "had a bite" if there was not time to go home. But, now, all that is changed for the most part; as instances, the Goodyear Tire and Rubber Company served

---

[1] *A Sketch of the Present State of Ireland, by an English Traveller.* November 14, 1817.

539,358 meals in 1922 and the J. B. Stetson Company furnished its employees with 182,000 meals in 1921.

The aim to supply workers with nourishing food is not philanthropic. It is founded on the idea that there will be subnormal production from undernourished workers and that the lunch box, the dinner pail, the nearby restaurant, the long walk home and back with carfare, may be avoided with comparatively little effort and expense by the employer.

The economic gain of preparing meals wholesale instead of retail can hardly be estimated and there is no doubt but that the saving of effort for employees' wives and mothers is very great.

Good lunch rooms depend on certain essentials some of which are lacking even today. Since they have been installed in some cases as an afterthought they have had to be placed where possible rather than where they can be easily reached. Accessibility is, however, important if a large attendance is to be expected. The lunch room, in contrast with the plant, should be as attractive as possible, a place of cheer, light, airy, neat and clean, all of which can be secured with little difficulty and should not be overlooked. The service should be prompt and available at all times in large plants or in those which work nights. The food should be of first-class quality, properly prepared and cooked, and the prices should be better than the best in the neighborhood. If these two essentials cannot be attained there is something radically wrong with the management. The system of payment should be simple, either by the provision of tickets paid for in advance or by placing coupons on the tray to be paid in passing out. The seating should be comfortable so that the meal is combined with a rest which ensures that full value will be returned in production; and, lastly, the food should be prepared by a professional and not an amateur.

The law provides in certain places, even if common sense did not suggest, that workers shall not be required to stay in workrooms during the lunch hour. It is undesirable, even if practicable, to allow workmen to eat in workrooms, which are often dusty and sometimes have poisonous materials. It is mandatory in some states that women should have an hour for lunch, unless a shorter time is authorized.

FACTORS TO BE CONSIDERED IN PROVIDING FOOD

Given the problem of providing food for the workers at the noon hour several factors have to be considered in determining how it should be accomplished. The personnel must first be considered. When sexes are about equally divided there may be a room for each or they may have separate portions of the same room. If there are only a few females, or a few males, with a large number of the opposite sex, a table is set apart in the main room. The eating habits of workers may also be considered; skilled labor will dine more opulently than unskilled workers, to whom quantity is of more importance than quality. Office employees will like table cloths, which are a superfluity for the factory force, though in some places they dine together, in which case there are no table cloths. If there is a large proportion of foreign-born workers, it is well to cater to their taste in food. The practice varies as to segregation of colored and white workers. In plants where colored labor has recently been employed, colored workers use the only lunch rooms available with white workers. Otherwise the tendency seems to be to provide a separate room.

In plants where the working hours are long there is more justification for a lunch room than in an eight-hour plant. If, as is often the case in eight-hour plants, there is overtime, food should be provided in the evening for those who remain. If the lunch period is short, workers will not have a chance to go home and provision of meals is advisable.

In a recent investigation made by the Industrial Commission of Wisconsin it was ascertained that 70% out of a total of 1,046 plants in that state had a lunch period of one hour, while 17.5% had a longer, and 12.5% of the plants had a shorter, lunch period. In a group of 952 of these plants only 17.5% provided warm lunches.[1]

The number leaving the plant at the lunch hour indicates the number which might be served in the plant. From them should be deducted those who live in the immediate vicinity. The maximum capacity of the dining room is also indicated by the maximum number on any one shift. It should be remembered that a certain percentage of these will continue to use lunch boxes and also that plants are growing and one may offset the other. If all the workers live in the vicinity, as in isolated communities, and have an hour for lunch, there will hardly be any special need for providing lunch facilities. Good restaurants in the vicinity lessen the need for a plant lunch room, provided the cost is not high. The Western Electric Company, with 29,000 employees, serves only 3,000 meals a day, principally because it is in a suburban district and near the homes of a large percentage of the workers.

During the past few years almost every available method of serving meals has been tried in factory experience. Some plants stick to the orthodox lunch room, where food is served as needed by attendants. In some cases the food is prepared and placed on tables ready for eating. In the cafeteria plan the food is prepared and placed on counters ready to be selected by the patron, who serves himself. A modification of this plan is where the worker brings in his own food in a lunch box or dinner pail and there is a hot plate for warming the food and hot coffee is supplied with cups. In some plants there is a food station or buffet, where pies, coffee, and milk are served in departments and independent of lunch room service. The Edward G. Budd Manufacturing Company, with 5,500 men and limited space, has what is called the "canteen" plan. A small lunch unit—7, by 8, by 9 feet long and of which there are

---

[1] *Wisconsin Labor Statistics, Industrial Commission of Wisconsin,* Vol. II, No. 11, November, 1924

14—is placed on each floor. In this two men hand out the food in portions that have been received from the main kitchen. There are a small gas stove and two small tables. No less than 87% of the employees are fed from these booths each day.

Another plan is the food wagon, which is wheeled into the department at lunch time. Food is served on a warm plate with compartments. In the plant of the Wahl Eversharp Company, of Chicago, workers hand in their orders in the morning and the lunch wagon is wheeled in to the department at noon time with the orders which are given out according to clock number. Two men are in attendance; one hands out the lunch and the other serves milk or coffee. The lunch cart has shelves for milk, coffee, and lunch orders. The company furnishes the space, heat, and light.

In large plants any or all of the above methods may be used. The Willys-Overland supplies food as follows:

TABLE 76

HOW THE WILLYS-OVERLAND COMPANY SUPPLIES FOOD TO ITS EMPLOYEES

Method Used	Number	Percentage
Cafeteria service	3,000	20.0
Box lunches	2,000	13.3
Rolling kitchen, sent to departments	1,500	10.0
Hot canteen, cooked outside, sent to departments	2,250	15.0
Men bring in own lunch	5,250	35.0

In 227 establishments, in 1918, the types of service given in Table 77 were found to be in vogue.

In the last few years there has, however, been a decided drift towards the cafeteria and it is now perhaps the commonest method of providing food. Lunch wagons and other plans of providing food for workers in their departments have the objection of making it likely that workers will eat in the workroom, under conditions unsuitable for the consumption of food.

TABLE 77

TYPES OF LUNCH SERVICE FOUND IN 227 ESTABLISHMENTS IN 1918[1]

Type of Service	Number	Percentage
Restaurants	128	42.2
Cafeterias	112	37.0
Room for those bringing lunches	34	11.2
Room for those bringing lunches, with coffee, and so forth	29	9.8

In determining on the location of a lunch room the center of the working population has first to be found, after which the availability of space needs attention. If possible the dining room should be north and the kitchen room on the south or leeward side.

If only existing buildings are available the basement or loft of the administration building may be used. Ventilation, which may be insufficient in the basement, is ample if the roof can be used. Rooms unoccupied during the lunch hour may sometimes be used or if a special building has to be erected it may be adapted to other purposes when not in use. The lunch room may be a single unit, as in small plants, or in multiple units for departments, being served from a central kitchen by means of motor trucks. The kitchen should be accessible to light, heat, water, steam, and gas.

In specially constructed lunch rooms the lower part of the walls should be enameled brick with the upper portion enameled in white. The floors may be of red tile, concrete painted, or linoleum. The windows should be large and wide opening inward, at least a tenth of the floor area. At the LeBlond Steel plant the lunch room is used at other times for motion pictures, dances, parties, plant inspection, and lectures, and the Edison and other companies use the lunch room as an auditorium.

In considering the layout it must be remembered that 23 hours are available for preparation and only one hour for service, and every arrangement should therefore facilitate service. Hence, the kitchen should be in the middle or on the long side of the dining room. The service counters should be between the kitchen and the dining room, and run parallel with the length of the room or project into the room at right angles to the length, particularly when the dining room is divided into two parts. This arrangement provides for a straight run for trucks from the kitchen to the counters, gives more space to patrons, reduces help in serving, and enables one person to attend to coffee and cashier's duties.

---

[1] "Welfare Work for Employees in Industrial Establishments," *Bulletin Number 250, United States Department of Labor,* February, 1919, p. 54.

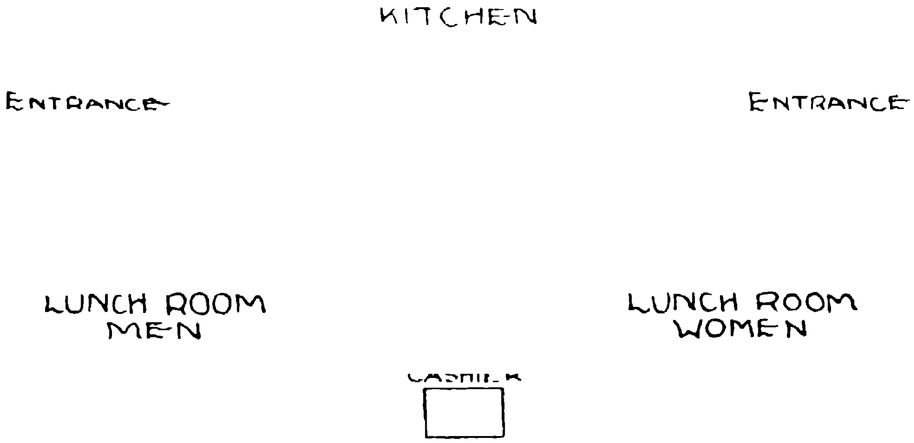


Figure Lunch-room layout

The question of attendance in planning a lunch room is somewhat puzzling. In an enquiry made by the United States Bureau of Labor in 1918 it was ascertained that in 181 establishments with over 605,000 employees there was an average attendance of 38%. In the Joliet Steel plant as much as 60% attended, and in the case of another company mentioned above 87% of the employees were served food in each department. Attendance varies. In the Stetson Company it began at 987 and rose to 1,300 at the end of the week, with a subsequent average of 1,400. It is always safe to count on 50% of the maximum number on a shift, but the employees themselves may be asked whether they will attend in case a lunch room is provided.

The Committee on Industrial Welfare of the Cleveland Chamber of Commerce gives the following area to be provided per employee:

TABLE 78

AREA PER EMPLOYEE TO BE PROVIDED IN PLANT LUNCH ROOM

Number of Persons	Square Feet per Person
25 and less	7
26- 50	6½
51- 75	6
76-100	5½
101-150	5
151-200	4½
201-300	4

In a typical plan of the United States Steel Corporation the following dimensions are given:

TABLE 79

DIMENSIONS OF TYPICAL LUNCH ROOM

	Size (feet)	Square Feet	
		Number	Percentage
Total Size of Building	38 by 61	2,318	100
Dining room	38⅔ by 38	1,469	65
Kitchen	22 by 28	616	27
Store	22 by 8	176	8

In a single unit to serve and seat 200 persons at one time there should be 4 chair tables of 10 square feet surface, 3-foot aisles and 4 feet between tables. Each person is allowed 12 square feet with a total area for seating of 2,500 square feet and 1,500 square feet for counter and kitchen. The following figures give the size of lunch room, the number of square feet, and the seating capacity in several well-known establishments.

TABLE 80

SIZE AND SEATING CAPACITY OF LUNCH ROOMS IN VARIOUS PLANTS

Name of Company	Size of Lunch Room (Feet)		Seating Capacity
Endicott-Johnson, Binghamton, N Y .	5 by 100	7,500	600
General Electric Co, Schenectady	0 by 80	5,000	400
Commonwealth Edison Co., Chicago	58 by	3,506	300
Illinois Steel Co., Joliet.........	30 by 100	3,000	350
Continental Motor Co, Detroit, Mich .	23 by 04	2,162	300
General Chemical Co., New York........	40 by 46	1,840	160
J I Case Threshing Machine Co .	35 by 60	2,100	500
Illinois Steel Co., South Works.... .	30 by 50	1,500	400

EQUIPMENT

The equipment consists of furniture, such as chairs, tables, desks; appliances, such as potato peeler, masher, bread mixer and slicer; and supplies such as linen, food, and so forth. There are one or two companies in each large city which supply lunch-room equipment. It is economy to buy the very best quality and as much labor-saving equipment as possible. For instance, aluminum pots and kettles cost more than other kinds but are more durable and cheaper in the end. The following equipment may be necessary for 100 and 250 persons respectively:

TABLE 81

LUNCH-ROOM EQUIPMENT

Equipment	NUMBER OF PERSONS	
Oven range for baking, hot plate for boiling		
Hot closet and warming cupboard	48x30x24"	72x30x30"
Boiler for vegetables	15 gallons	20 gallons
Boiler for tea water, washing up, and so forth	15 gallons	25 gallons
Boiler for soup		10 gallons
Potato and pudding steamer		1

The following equipment list suggests the items which may be required in equipping a lunch room.

Dining Room

Counters
Cash register
Tables
Chairs
Railings
Curtains
Draper mat
Waste-paper basket

Store

Refrigerator
Chopper

Kitchen

Steamers
Boilers
Carving table
Oven range
Roast oven
Grill
Steam table

Bakery

Oven
Breadcutter

Pantry

Cutlery
Shelving
Breadcutter
Silver basket
Crockery

Scullery

Dishwashers
Pot washer
Silver cleaner

In 1913 the National Electric Lamp Works, of Cleveland, determined the cost of a lunch room for 240 persons on the cafeteria plan at $2,016, which figure would be about doubled today. The furniture and table equipment cost 43%, the counter equipment cost 31.5%, and the utensils and equipment cost 25.5% of the total. There has been a great change from the table d'hôte to the cafeteria type in the last few years not only because of the quickness with which persons can be served but also because of the great economy in labor. Dr. Sanford DeHart states that a company lost $9,000 on a lunch room but, on changing to a cafeteria, saved $5,500 on wages for help. The cost of the installation was $5,500. The breakage was reduced 50%. This agrees with the experience of several other companies. The Metropolitan Life Insurance Company paid $384 for table service and $296 for cafeteria service, a saving of $88 per week, or $4,576 per year. In the General Electric Company plant, Schenectady, it was found that 50 waiters were necessary to serve 1,000 persons. By switching from the lunch room to the cafeteria service the expense of waiters was saved. Each person serves himself at a much quicker rate than is possible when one waiter has to serve 20 persons. The most comprehensive information on the cost of lunch rooms will be found in an article by Russell J. Waldo, in the April issue of *Management and Administration,* page 342.

THE MANAGEMENT OF LUNCH ROOMS

In an enquiry made into the management of lunch rooms in 1918 the following facts were elicited:

TABLE 82

TYPES OF LUNCH-ROOM MANAGEMENT IN VARIOUS PLANTS IN 1918

Management	Restaurant	Cafeteria	Room Alone	Room and Coffee
Company, with subsidy	109	98	34	29
Contractor, or concessionaire	14	6		
Employees, cooperative	4	68		
	127	112	34	29

The position has changed somewhat; the tendency since that time has been steadily towards the cafeteria rather than the restaurant, letting the employes manage alone or in cooperation with the plant staff. Company management has proved satisfactory, assuming the employment of a thoroughly competent lunch-room manager who is directly responsible. Several caterers are willing to manage plant cafeterias on a percentage basis, but the system has rarely been satisfactory to any one but the concessionaire. Of recent years there has been a tendency, under the influence of employee representation, towards joint management. The Wisconsin Steel Company, Cincinnati Milling Machine Company, the Benjamin Electric Company, of Chicago, the Jeffrey Manufacturing Company, of Columbus, Ohio, and the Whittaker-Glessner Company have committees which manage the lunch room. Where employees take part in the management they are less free with criticism than otherwise. In the Wisconsin Steel Works the directing board is made up of 10 employees elected by their fellows. Members serve for one year and the committee meets every three weeks, being assisted by a labor and lunch-room manager.

In the Benjamin Electric Company there is an advisory committee of employees elected from the members of the Employee's Fellowship Club. The company, however, employs its manager and looks to him for efficient results. At the Northwest station of the Commonwealth Edison Company the lunch room is operated as an employees' business, although the company furnishes the building and pays the salary of two cooks. Dues of $1 per man are paid weekly by the men to cover the cost of provisions required.

The lunch-room manager must be a man of experience in such work. He must have the practical ability to choose good quality food, to judge prices and to handle help. If, in addition, he has a knowledge of dietetics it is advantageous. The staff for a cafeteria should be about 3% of those served at one sitting, somewhat as follows:

TABLE 83

CAFETERIA STAFF

Staff	Seating for		
	100	500	1,000
Cook.	1	2	3
Assistant servers .	3	10	20
Cashier and tickets	1	2	4
Storekeeper. .	1	1	2

The Kodak Company, Rochester, has a full-time staff of 69 and a part-time staff of 100 to serve 4,500 meals. Fixed charges for help are a large item in the budget. In one plant with 4,000 employees there was a manager, a plant storekeeper as an assistant, and 9 men. When the plant is operated 24 hours, two sets of help are required. It is advisable to limit the permanent staff and to utilize either part-time help or employees who can give an hour or two during the rush to serve and clear off the tables.

The elimination of waiters in the cafeteria plan reduces the expenses considerably, since it is necessary, where they are used, to have one waiter for each 20 lunchers.

It is not customary to serve meals free. A large insurance company, however, serves about 4,000 free meals a day as a supplement to wages. A mail-order house gives breakfast to workers who attend to the morning mail. Several companies make a practice of giving free supper to those who work overtime, while some give free coffee at midnight. Twenty-nine companies furnish coffee free for all, one furnishes free soup, and several supply tea and milk free of cost. The general practice is to serve meals at cost without making any charge for overhead. By this arrangement workers can get a satisfactory meal for about 25 or 30 cents, by the cafeteria plan.

The extent of the service varies. Some firms give breakfast to boarders or early workers. Where there is night work the lunch room is open all night. The Austin Company gives a "mid-period" lunch served in the middle of the forenoon or the middle of the afternoon. Some companies have the lunch room open all the time, especially where men are on piece-work. They eat between heats in forge-shops or in heat-treating departments. In the Keystone Steel and Wire Company the workers are on two shifts and eat irregularly between heats.

Under the cafeteria plan meals can be served very expeditiously. In a women's cafeteria 500 employees have been served in less than 15 minutes. The following is a description of the service at the plant of the General Electric Company, of Schenectady, by means of the cafeteria plan:

> After the men file past the cash register, they approach at right angles to the end of one of the four belt conveyers. Adjacent to the nearer end of the belt conveyer the ticket is exchanged for an aluminum tray which is laid on the conveyer belt. These belts travel at the rate of 65 feet per minute and allow 15 seconds for the customer to select his food. Following his tray he helps himself to either meat or fish, then potatoes, tomatoes, pudding or pie, and milk or coffee, all awaiting him on a hot steam table, parallel to the belt. By this time his tray is

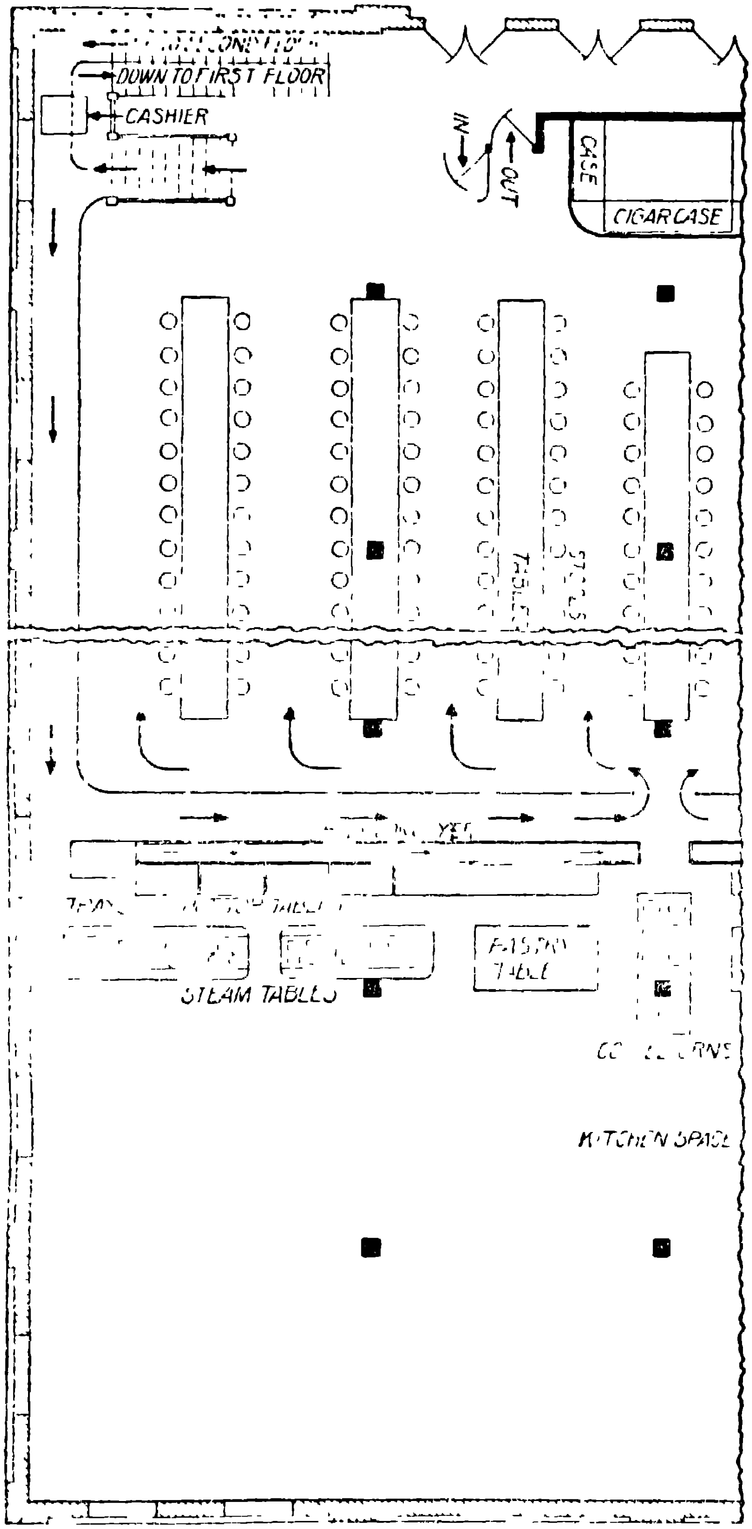


Figure 16: Plan of portion of first floor of Schenectady Works' restaurant, showing arrangement of tables, belt conveyers, kitchen, and route of patrons

> within 5 or 6 feet of the end of the belt, where the contents of the tray are checked.
>
> After removing his tray from the conveyer belt the diner takes it to his seat . . . tickets are sold only up to seating capacity. . . . Each of these conveyers serves from 30 to 40 people per minute, and since there are 4 of them, 120 to 160 meals can be served each minute during the noon period.

There are several systems of payment for meals. In some cases tickets of different colors represent different money values or there are ticket books, costing 90 cents for a dollar book. Sometimes metal checks of varying values are issued, but cash is paid in the majority of cases. Usually the diner is given a check to the value of his purchases on his tray as he leaves the counter and he pays its amount to the cashier on leaving. In one case it was found best to have sufficient cashiers to take cash as the worker left the counter. In the General Electric Company it is found that the cashiers can sell and make change for 20 tickets per minute.

Very few companies secure, or aim to secure, a surplus in the management of lunch rooms. If there is any profit it is devoted to the provision of better value for the workers. The Westinghouse Company, for instance, is frankly run at a loss in order to furnish food at the lowest possible price, as is that of the White Motor Company, and the deficit is made up by a special fund. The Metropolitan Life Insurance Company makes no attempt to reduce the cost of operation by payment for food. The general tendency, however, at present is to provide good and cheap food and stand the loss if there is any. The present condition of affairs is indicated by Table 84, on the following page.

The lunch room of the Government Printing Office at Washington is financed and managed by the members of the Employees' Association and for the month of January, 1923, the receipts per meal were 10.8 cents and the average cost was 18.9 cents. As companies change from the

TABLE 84

RESULTS OF LUNCH-ROOM OPERATION IN 46 COMPANIES

Number of companies reporting	46	100.0%
Number reporting a deficit	35	76.0
Number self-supporting	9	20.0
Number with a surplus	2	4.0

restaurant idea to the cafeteria plan fewer will be run at a loss.

The advantages of supplying food to workers are numerous if indeterminate. The employer who has a successful lunch room in operation is able to secure and keep help to the disadvantage of the neighboring plant which has no such accommodation. A lunch room may thus be considered to affect turnover favorably. Good food improves the health unquestionably and in so far as the employer has improved upon what workers can do for themselves, he may have attained that end. Good health, in its turn, reduces fatigue; there is less tendency to sickness and consequently less absentism, increased efficiency, and greater bodily comfort. If the food is cheap, workers who not infrequently economize on food are induced to buy enough to maintain their strength, thus benefiting themselves and indirectly the employer.

Food, which can be obtained on the premises without loss of time, gives more leisure to the worker during the lunch period and also enables the employer to reduce the span of the lunch period without hardship. It may be interesting to note here that there is a tendency to make the lunch period shorter than formerly. In an investigation made a couple of years ago it was found that, out of 150,000 employees in various establishments, 70% had half an hour for lunch and only 30% had an hour for lunch. The shorter period is possible only when there is lunch to be obtained on the premises. Lunch at the plant relieves the home burden and also tends to get the workers out of the workroom during lunch, thus providing the opportunity for ventilation, sometimes badly needed. Dining together, instead of dining separately, enables workers to form acquaintances with men in other departments and this circumstance promotes plant solidarity.

The spectacle of a worker, a recent experience, heating a herring on a shovel over some molten metal, makes one feel that hot food in pleasant surroundings might not be unappreciated.

XXI

FATIGUE REMOVAL, REST PERIODS, AND SEATING

Loss due to industrial fatigue Nature and effect of fatigue Signs of fatigue Factors in fatigue extrinsic and intrinsic Cause of fatigue Hurry and monotony Avoiding fatigue Hours and wages Posture. Rest periods Rest-rooms Seating

THE late Frank Gilbreth, in his own incisive way, claimed that the average loss due to fatigue amounted to 20 cents per worker per day, or a billion and a half in dollars for the year. If this be so, the loss is three times as great as that due to fire for the whole country. But the latter is a spectacular occurrence and so strikes our imaginations. The whittling down of the working capacity is a silent process and tends to pass unnoticed. Until a few years ago, in fact, we heard much about the fatigue of metals and but little of human fatigue, yet steel has more ability "to resist repeated stresses" than humanity.

The ever-pressing demand for greater production per person, particularly during the Great War, brought industry face to face with the fact that long hours do not necessarily mean greater production, though this theory has been generally held by those who have never made any specific study of the subject. The revelations of output in the production of munitions did show, in a palpable way, that workers tire, and slacken effort as a result. It was demonstrated that fatigue is uneconomical, bringing in its train less output and more sickness than in cases where the worker has not been pressed for production. The very effort to procure production, without reference to the limits of endurance of the human organism, defeats its own purpose.

Industrial fatigue, however, has received considerable attention in the past few years, and innumerable articles have appeared of late indicating that fatigue study is a complex subject. In England, fatigue study, begun in 1913, is now conducted by the Industrial Fatigue Research Board.

Although we are not fully aware of the nature of fatigue we are quite conversant with its effects. Fatigue is the very antithesis of efficiency to which the employer looks for production. It has been described as "the sum of the results of activity which show themselves in a diminished capacity for doing work."[1] Goldmark describes it as, "Nature's warning signal that the limit of physical activity has been reached,"[2] and another authority says it is, "that bodily condition which results from undue physical exertion and shows itself in diminished output and overtaxed strength." Fatigue, in fact, is not easily defined, and Muscio, appreciating this, suggests that it is more important to determine the effects of activity than to ascertain the presence or absence of fatigue.

The body may be compared to an internal combustion engine the energy of which depends on the food stored up and the ability to use it plus the ability of the body to absorb oxygen and burn the fuel or food absorbed, and the ability to get rid of the waste products. The food we consume is converted into chemical energy which is stored up in the muscles and capable of being turned into mechanical power. If the latter becomes exhausted the condition of fatigue arises, partly because of the depletion of the energizing material and partly because of the production of waste products and poisons.

There are several types and degrees of fatigue. According to Flynn,[4] it may be objective or subjective. Objective fatigue is that made evident by diminished output. Subjective fatigue is that kind which shows itself in muscular tiredness, in a general feeling of tiredness or in sleepiness. Normal fatigue is that which may be overcome by a night's rest; cumulative fatigue is the "hangover" not compensated for by the normal resting period. It is naturally difficult to differentiate between the two, hence it is best to take steps to reduce normal fatigue in order to avoid its cumulative effects. Time is an essential factor in determining the character of the fatigue. The "day's fatigue," according to Hayhurst, shows itself in the "tired look," lack of "pep," and in spoiled work. It is evanescent in character and is dissipated by rest. The "week's fatigue" is a chronic feeling of listlessness, indisposition, which becomes evident by loafing on the job, absence from work, lack of morale, and incorrect mental and physical attitude. "Month's fatigue" results in bodily affliction, complete loss of morale, and unsatisfactory work.

---

[1] "Health of Munition Workers Committee," *Report Number 7.*

[2] Goldmark, Josephine *Fatigue and Efficiency*

[3] Hope, Hanna, and Stallybrass *Industrial Hygiene and Medicine.*

[4] Flynn, F. B. "Industrial Aspects of Human Fatigue," *Journal of Personnel Research,* Vol II, No 7, November, 1923, p. 280.

"The true sign of fatigue is a diminished capacity for work." Therefore, measurement of output is the best (objective) test—assuming, of course, a willingness to work. But it is not always an infallible test. Output may fall because of physical deficiency; a "man may be tired because he is ill, or ill because he is tired." The importance of sickness in relation to fatigue should not be overlooked, since it is known that the sickness rate is high. Workers do not produce the same amount from hour to hour. Although the "Ideal Work Curve" [1] should show a slight but steady increase from hour to hour and day to day, the tendency seems to be to increase production for an hour and then drop steadily for the remaining of the working period, and repeat the performance with a greater drop in the afternoon. Another factor enters, not only the drop in quantity but also the decrease in quality.

The worker, himself, displays fatigue in looks as well as in actions. Fatigued workers are unsteady; in order to recuperate from the demands made on the physical structure they absent themselves periodically from work, they are late and subject to accident, particularly in the latter part of the day, as statistics show.

---

[1] Bedford, Thomas. "The Ideal Work Curve," *Journal of Industrial Hygiene,* October, 1922, p. 235

THE FACTORS IN FATIGUE

The Woman's Bureau, New York State Industrial Commission, prepared the chart reproduced in Figure 17, on page 388, to show the various factors involved in fatigue.

These factors may be classified as follows:

1. Extrinsic, or mechanical
    (*a*) Processes
        (1) Speed, monotony, vibration, noise
        (2) Intensity, difficulty, strain, posture
    (*b*) Working conditions
        (1) Length of hours, wages
        (2) Ventilation, heating, lighting, humidity, temperature
        (3) Fire and accident hazards
        (4) Food, water
2. Intrinsic, or psychological
    (*a*) Worker as an individual
        (1) Age, sex, race, physical condition, clothing, diet
        (2) Transportation, housing, home conditions, family cares
    (*b*) Worker as regards his work
        (1) Adaptability, experience, training, practice
        (2) Security of tenure

Of the various factors above mentioned those in the first group are, on the whole, the more direct and important causes of fatigue. With the advent of employment management and consequent selection of the worker for his job it is quite probable that fatigue of a personal nature has been reduced. Concurrently, of course, there has been

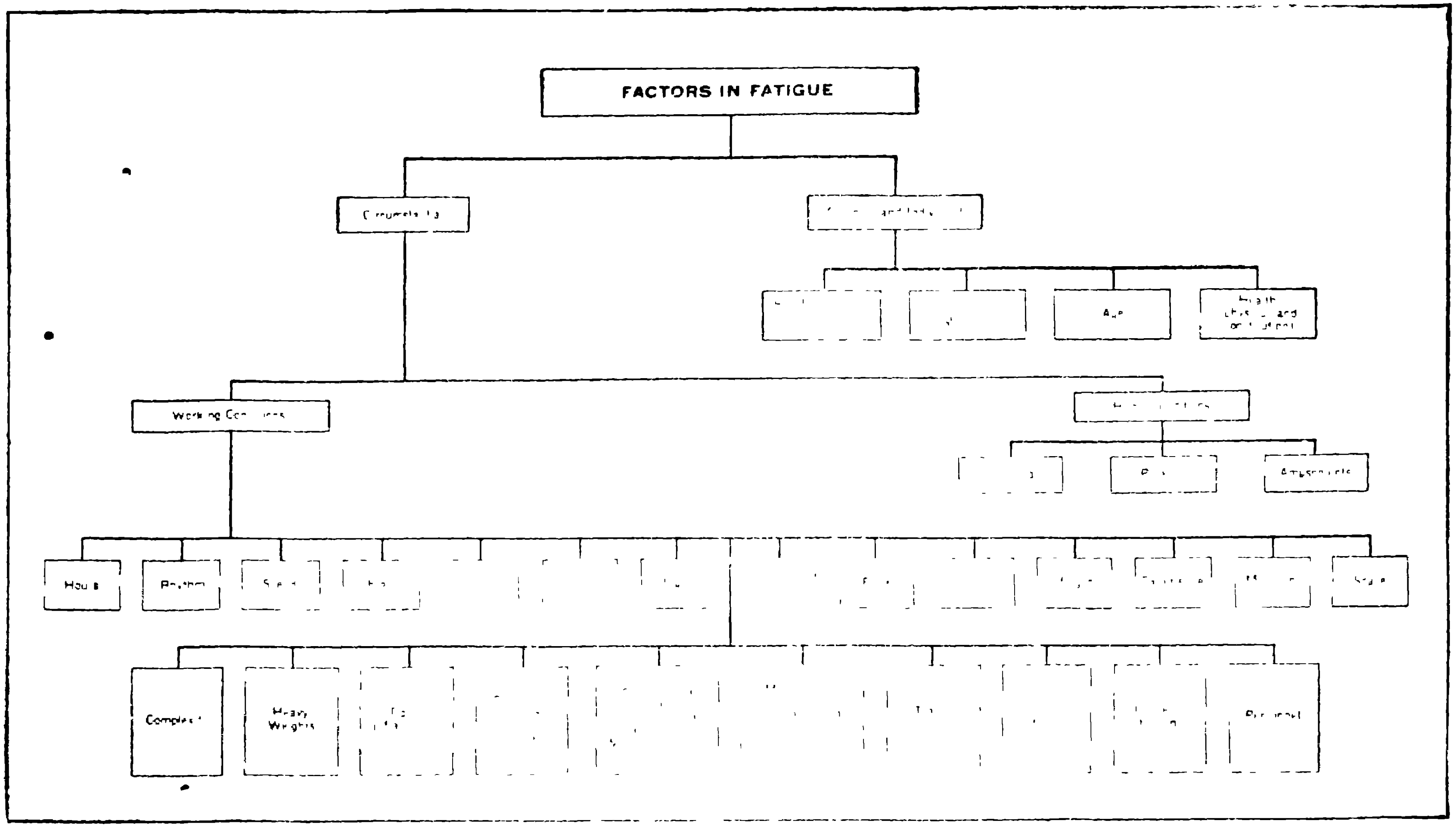


Figure 17: Chart designed to show lines of investigation involved in fatigue studies and their several relations to the problem as a whole

some attempt to adjust the job to the worker, and, for instance, to determine the best rate of working speed. The amount of work that has been done along this line has been small as yet, and even though the importance of reducing turnover has been recognized, the relation between the employer and employee is still more casual than permanent. Thus, "the best rate of speed" on a long-term basis is difficult to establish. Workers who are physically unable to keep pace with the established rate soon become fatigued.

Were an employer to set out and investigate the best rate of speed for each job he would find some cases of underproduction and other cases of overproduction in terms of effort. He would be able to secure "the optimum of speed and effort" all round, thereby reducing fatigue in some and increasing production in others. "To illustrate this, let us consider the performance of 1,000 foot-pounds of work per minute, (1) by raising 200 pounds a distance of 6 inches, 10 times per minute, or (2) 20 pounds 2 feet, 25 times per minute, or (3) 2 pounds 2½ feet, 200 times per minute. Though the rate of doing work is the same in each case, methods (1) and (3) will tire a man much more quickly than method (2)—(1) by excessive effort, (3) by excessive speed. Between these extremes there will be an "optimum effort and speed" somewhere about that given in (2)."[1]

Monotony, for some workers, just as variety for others, is conducive to fatigue. It is, perhaps, easier to select workers who like the one or the other than to avoid the monotony inevitably associated with mechanical repetition. Change of occupation is always a relief from monotonous jobs. Vibration and noise, eminently present in the use of the air-drill, are a quite obvious source of fatigue. The intensity and difficulty of some jobs, straining and reaching, in others, are factors quite common in various industrial processes, all of which add to the distress of the worker if prolonged.

---

[1] Orenstein, J., and Ireland, H. J. "Experimental Observations upon the Relation between Atmospheric Conditions and the Production of Fatigue in Mine Laborers," *Journal of Industrial Hygiene*, January, 1922, p. 30.

Intrinsically the worker is subject to various factors more or less predisposing; as, for instance, age, sex, race, physical condition, clothing, and diet. It is obvious that a body of workers will be far less subjected to fatigue when chosen with reference to the demands of the occupation. Persons of suitable age and sex, as determined by the employment office, of good physical condition, as determined in the medical department, properly clothed and fed, will be almost immune to ordinary demands on the physique. If there is a training department to adapt a man to his job and teach him "the one best way," so much the better.

Some workers are fatigued, not because of their physique nor on account of the nature of the work, but from factors lying outside the plant. The young woman who stays out all night dancing feels fed up from work at the word "go"; those who are movie fans feel the strain of eyes at work but not due to work. Others have difficult and tedious transportation problems twice a day because they have been selected in the employment office without reference to the location of residence, and fatigue results. If home conditions are unsatisfactory and there are family cares, the result is psychological, if not physical, fatigue. Another source of worry is due to a feeling of impotency and hence insecurity in the job.

The relative importance of such a multiplicity of factors is not easy to determine. Dr. E. R. Hayhurst suggests the following: [1]

Hurrying piece-work	41%	Speeding up	12%
Monotony of operation	37	Laborious work	9
Standing still	25	Long hours	8
Eye-strain	16	Chair without back-rests	8
Faulty posture	15	Constant and prolonged strain	6
Jarring processes	13	Pressure against body	3
Loud noises	12		

---

[1] *Ohio Public Health Journal,* Vol. V, January, 1915, p. 25.

It will be seen that hurrying piece-work—in other words, speed—is the principal cause, yet the employer must have maximum output, but he can secure it only when he discovers the optimum speed at which efficiency is maximum, and the fact that fatigue exists is an indication that the optimum speed has not been found. The optimum speed is that speed which can be maintained without undue fatigue over a long period.

The scientific estimation of cumulative fatigue is as yet a problem. Spaeth says, "An exact quantitative test for cumulative fatigue has not been discovered." Various ingenious instruments are in use; the myograph to show how loss of energy results from noxious substances in the muscles producing work, the ergograph to record the contraction of the muscles, and the ponometer to record the mental effort required to accomplish muscular work.

While the estimation of fatigue remains one of difficulty, certain obvious remedies have the merit of comparative simplicity, since they fit in largely with modern ideas of good plant and labor management. Fatigue elimination begins with the selection of the worker, who must be chosen for the work which suits him temperamentally as well as physically, according to his experience and his aptitudes, and for this purpose there must be available a job specification which sets out at length the items which compose the job. The secretary of the Canadian Committee on Industrial Fatigue considers inadaptation of the worker to his job one of the chief causes of fatigue. The employment manager is assisted in his selection by the plant physician and the oculist. Hayhurst, it may be noticed, finds eye-strain a frequent cause of fatigue. After selection, the worker may be trained how to do his work in the easiest way and if inadaptable, may be transferred to some other job. Should fatigue be a pronounced feature in any specific occupation, its incidence may be removed or at least mitigated by the change from hand to mechanical operation in stoking, for instance, or by the substitution of rubber for metal tires where noise is a factor, or by the use of ball or roller bearings in hand trucks where pushing is laborious. Personnel management demands a closer relation with the worker whereby such sources of fatigue and grievances may be ascertained and removed.

The physical examination of the applicant, as well as the periodical examination of the regular employee, discloses physical weaknesses and tendencies which induce fatigue, and in the case of sickness the doctor is able to recommend work suited to altered physical capabilities. Then, there is the duty of health education whereby the worker can be trained into better and more hygienic habits of working, living. bathing, and eating.

In working conditions a long list of factors tend to create fatigue. The length of the hours should be adjusted. overtime eliminated, and rest periods instituted at the time of the forenoon and the afternoon when production tends to drop. The adjustment of the hours of labor is a scientific rather than a [illegible] and search should be made for the length of the working day that a normal man could work without injury to his health or without shortening his life.

The shortening of the working day, forced in some instances to an issue by the unions has produced some remarkable results. In 1896 the Illinois coal miners went from a 10- to an 8-hour day. They produced, in the three years previous to the change, an average of 2.7 short tons per man per day. In the three years following the change they produced an average of 3.2 short tons per day. In an investigation made by the Fatigue Research Board,[1] as to the production of steel and pig iron in England, "the hand charging of pig iron was found to be a very laborious operation, and of 146 blast furnaces inspected only 18% were mechanically charged. The rate of charging was 16% less in summer than in winter, and the rate of charging on long shifts was 8 to 15% less than on 8-hour shifts."

---

[1] Vernon, H. M. "Fatigue and Efficiency in the Iron and Steel Industry," *Industrial Fatigue Research Board, Report Number 5*, 1920.

When viewed from its immediate results by the employer a change from a 10-hour to an 8-hour day may be discouraging because it takes time for workers to adapt themselves to the rate of speed necessitated by the change, but if employment be regarded from the view-point of turnover, the following statement of Lord Macauley, 70 years ago, is significant. He said:

> I do not mean to say that a man will not produce more in a week by working seven days than by working six days. But I very much doubt whether, at the end of the year, he will generally have produced more by working seven days a week than by working six days a week; and I firmly believe that at the end of twenty years he will have produced much less by working seven days a week than by working six days a week.

Wages affect the situation indirectly but nevertheless distinctly. Small wages force men to work overtime, to work "on the side," or to walk to and from their homes. The equitable adjustment of wages is another factor together with the maintenance of wages at a level which will not necessitate economy on food.

The large and complex question of ventilation has already been considered in a previous chapter, together with its contributory factors of humidity, heat, in relation to production, and it was shown that production falls off in unsuitable atmospheric conditions. The falling off in production is not due directly to atmospheric conditions; it is due to fatigue which results from them. The Industrial Fatigue Research Board (England) has made extensive studies of "Efficiency in Fine Linen Weaving," "Atmospheric Conditions in Cotton Weaving," and many other studies of a similar character.

It is obvious that the provisions of nourishing food should contribute to the elimination of fatigue, and the situation has been met in part by the establishment of factory lunch rooms. A further step is the dispensing of the "balanced ration" or at least food of adequate calorific value as is provided by such companies as the General Electric Company. Workers are notoriously guilty of errors of diet; they economize on good plain food and are extravagant on those which lack nourishment.

Incorrect posture, often due to badly designed machinery, faulty design of tables and benches, lack of opportunity to sit at intervals, and unsuitable chairs, contributes to bodily discomfort and ends in fatigue. The worker is the last court of appeal in seating, yet he is seldom consulted either as to the need of a chair or as to its design when supplied. In the case of one factory chairs were supplied but not used by the woman operatives. Later the chairs were redesigned, and, "The result has been surprising; the number of movements has been materially reduced and the girls are very much fresher at the end of the day's work than formerly when they had been standing. These two causes have in every instance led to an increase in output and earnings, usually from 10% to 20%; also, what is very important, the girls are able to enjoy their evenings better, as they are not so tired, and they come into their work fresher next day." [1]

Many sources of fatigue may be removed by providing the proper tools and equipment. Taylor's famous experiment in coal shoveling springs to mind; by providing the proper-sized shovel he succeeded in getting a much larger tonnage at a less expenditure of strength. The use of such equipment as conveyers and belts, block and tackle, levers, and hammers of the proper weight suggests itself, but it is often overlooked because the performance of work is not looked at from the view-point of fatigue elimination. In chocolate packing it was found that by introducing a new type of bench and arranging the varieties of chocolates in a more convenient way for selection, so as to increase the rhythm of the movements and diminish the need for voluntary decisions, the output was increased 36%, though part of this improvement was due to the maintenance of a more regular supply of chocolates. In another instance, in the manufacture of tin boxes, the size of the piece of short metal supplied to the workers was found to be unsuitable. On substitution of a better size, a saving of time amounting to from 30% to 40% was effected in some instances. The sheets of tin were not kept at the right height, and the girls had to stoop to pick them up. By placing the sheets on a box, the stooping was avoided, and the time of completing the stamping operation was reduced 9%. These changes, besides increasing output, reduced fatigue. The importance of reducing fatigue is that besides increasing the comfort of the worker it also tends to secure greater output for the same effort.

---

[1] "Seats for Workers," *Welfare Work*, London, July, 1924, p. 137.

REST PERIODS

As a means of relieving fatigue it has been found advantageous to introduce rest periods into certain establishments. A rest period is a cessation of work for a definite length of time within the working period. It is a simple device for relieving tension in continuous or monotonous work and, according to Spaeth, "affords one of the most economical and rational methods of reducing normal fatigue in industry."[1] Other occupations though heavy in character do not need such rest periods since the nature of the work necessitates change which is tantamount to rest. The advisability of mitigating normal fatigue in order to stave off the approach of pathological fatigue has already been pointed out and the adoption of a rest period is a means of distributing the strain of steady, unremitting toil.

Rest periods, or pauses, breaks, changes, or recesses, as they are sometimes called, must be distinguished from those cessations of work taken either through the physical need, the impulse of the moment, or sheer laziness. Theoretically an employee is working during the whole period; practically he is busy only when the boss is looking at him in some occupations and in others there are more or less furtively recognized breathing spells. Rest, with the fear that the foreman will discover it, is no real rest at all and there is probably more time lost in the effort of deceiving the foreman than had properly constituted rest periods been instituted. The Health of Munition Workers Committee, in its Interim Report, pointed out that, "Careful observation shows that during working hours the women on day shift took voluntary rest pauses which amounted altogether to over an hour out of the 10-hour day, in addition to the hour or so of compulsory rest required for attention to their machines by the tool-setters. These rests were taken at irregular and often unsuitable intervals." It is quite probable that in the institution of rest periods there would be an actual gain of time at the machines and no real loss of time from work as is generally supposed.

---

[1] Spaeth, Reynold A. "Prevention of Fatigue in Industry," *Industrial Management,* February, 1920, p. 121.

The rest period is really an alternative to change of occupation and may be introduced where change of occupation is impossible. The Joseph & Feiss Company, of Cleveland, tells us, "Our work is arranged so that our operators, the majority of whom are women, must leave their work tables on an average of 4 times an hour for the purpose of having time slips checked, procuring new and returning finished work. This amounts to about 30 minutes in an 8-hour day." Such changes are, of course, the equivalent of rest periods.

The purpose of rest periods is to increase production by reducing temporary fatigue and preventing the onset of pathological or cumulative fatigue, and that it is effective may be judged by its wide increase during the last few years. In an investigation made in 1916-1917,'the particulars given in Table 85 were ascertained.

These figures were gathered from the result of an investigation of 431 plants reporting 1,662,000 as the number of employees. Only 4.16% of the total had rest periods.

TABLE 85

REST PERIODS IN INDUSTRIAL ESTABLISHMENTS, 1916-1917 [1]

Particulars	Male	Female	Total
Establishments granting rest periods....	55	85	106
Employees in above establishments......	166,759	111,027	446,122
Establishments reporting number to whom rest periods are given.........	31	50	62
Employees in above establishments.....	64,025	56,337	216,062
Employees having rest periods.........	19,589	49,027	69,073

Of 106 establishments reporting as granting rest periods to all or part of their employees, 62, with a total of 216,062, grant rest periods to 69,073, or 32% of the total.

The National Industrial Conference Board made an investigation, presumably in 1918, by means of a questionnaire, and the following results were received:

TABLE 86

ANSWERS TO A QUESTIONNAIRE RELATING TO REST PERIODS FOR INDUSTRIAL WORKERS [2]

Number of establishments from which information was solicited	388
Number reporting that they had tried rest periods...	104
Number reporting discontinuance of practice......	15
Number of companies reporting no usage of rest periods	129
Number of companies making no reply to questionnaire	155
Companies granting rest periods to selected employees	61
Companies granting rest periods to all employees...	21
Total employees in establishments granting rest periods to selected employees..................	370,498
Total number of employees in above having rest periods	142,498
Number of women in total having rest periods......	136,331

---

[1] "Welfare Work for Employees in Industrial Establishments in the United States," *Bulletin Number 250, Bureau of Labor Statistics*, Washington, D. C.

[2] "Rest Periods for Industrial Workers," *Reseatch Report Number 13*, January, 1919. National Industrial Conference Board, New York.

In the figures given in Table 86 the number of employees in all the establishments reporting is not mentioned and it is not possible to determine the percentage having rest periods. Out of 72 companies which mentioned the date upon which rest periods were introduced, only 23 were in operation before 1914 and 49 introduced them in 1914 or later. It will, therefore, be seen that rest periods are the exception rather than the rule, but as our knowledge of their use and effect increases they are almost certain to be increasingly popular. In some companies rest periods have been used for a long time and the general practice seems to be to have them for selected employees.

The use of rest periods has received legal sanction only in a few isolated cases, though in effect restriction of hours for women is a tendency in that direction. In New York and New Jersey the hours of workers in compressed air must be provided with a rest period varying in length from half an hour to 5 hours according to the degree of pressure. In certain occupations in Belgium women in fruit preserving must be allowed at least 15 minutes in every 5-hour work period in addition to the noon rest, and in chocolate and confectionery manufacture 15 minutes is allowed if the working day is over 9 hours.

The rest period is no more universally necessary than the eight-hour day. The following indicate, in a general way, the kinds of work to which it may apply:

Repetitive, rather than non-repetitive work
Constant, rather than intermittent work
Hard, rather than easy work
Fast, rather than slow work
Monotonous, rather than varied work

It applies to women rather than men, to old rather than young, to day-, rather than piece-workers, and to long, rather than short hours. Occupations that peculiarly necessitate periodic cessations of work are those involving intense concentration, such as telegraph and telephone operation, many clerical jobs, and calculation and proof-reading.

Any occupation which necessitates the maintenance of a constant position for four hours is bound to cause fatigue, even if it be a position of the most natural kind, such as standing, walking, sitting, or holding the arms in the position necessary for typewriting. Any occupation to which a person is unaccustomed is bound to be tiring until practice attunes the muscles, and in such cases periods of rest are decidedly advantageous. Work that requires constant standing, sitting or walking is generally benefited when opportunity is given for a change.

> Work on power sewing machines is a type of occupation which involves close application and strain on eyesight as well as a cramped position resulting in fatigue, which may be considerably relieved by occasional pauses. Repetitive machine operations were generally regarded by employers . . . . . as allowing so little opportunity for change and relaxation that rest periods were desirable.[1]

The Industrial Fatigue Research Board has recently published a report on the influence of rest pauses on light repetitive work. A group of 17 girls engaged in labeling small packages were tested for 20 weeks before the rest period and for 17 weeks after a 10 minutes' pause was allowed in the middle of the 4½-hour morning spell of work. Their output slowly improved, and in the last 6 weeks of the rest period it was 13% greater than in the pre-rest period, in spite of the loss of 2% of working time. At a boot and shoe factory, a group of 5 women engaged in sewing uppers were tested for a 32-week period and they showed an 11% improvement after the introduction of a 10-minute pause in their 4¾-hour morning spell of work.

The introduction of rest periods should be determined, not only by the considerations mentioned in the three preceding paragraphs but also by a study of output, its quantity and quality. If production tends to flag after an hour or two, and there are no other apparent factors causing the drop, it is safe to assume that production will be benefited, if not maintained, by the institution of a rest period.

---

[1] "Rest Periods for Industrial Workers," *Research Report Number 13*, January, 1919, National Industrial Conference Board.

> Whenever an industrial process involves heavy work or work requiring constant standing or sitting, and especially when the task is repetitive and demands constant and close attention, rest periods should be introduced.[1]

Whether it is advisable to apply a rest period to all employees or only to a portion depends on the character of work and the employees. In plants where the vast majority are females it is hardly worth while making exceptions. It is, however, better to select that occupation which seems to justify the institution of rest periods most and to ascertain whether the benefit is so apparent as to make an extension of the practice advisable.

Likewise, the length, frequency, and intermittency of the rest period are mainly determined by the work. Effort should be made to adjust the length of the rest period to requirements; it should be long enough to allow recuperation yet not so long as to bring about a loss of practice. Usually the rest period is 10 or 15 minutes and it is placed within each working period at a time when production seems to be falling off. Possibly it would be wiser to anticipate by introducing the rest period in the earlier part of the forenoon and afternoon with the object of forestalling the onset of fatigue. In certain occupations it has been found that longer periods are desirable. The Sefton Manufacturing Company, for instance, allows its women operatives two 20-minute periods. Taylor discovered that in the inspection of ball-bearings a 10-minute rest was advisable every hour and a quarter.

In some plants although a rest period is provided, there is no opportunity to rest. In others a rest-room is provided where women can rest in the ordinary way in comfort. An idea generally gaining ground is that not rest but recreation is the need, a sort of setting-up-after-letting-down idea.

---

[1] Spaeth, Reynold A. "Prevention of Fatigue in Industry," *Industrial Management,* February, 1920, p. 121.

Drills, dancing, calisthenics, and the like, are all right for sedentary workers, but it is best to stick to the rest plan for factory workers who are not doing sedentary work. In some instances crackers and milk, coffee and rolls, chocolate and other comestibles are provided during the rest period. In the office of the Collins Manufacturing Company, afternoon tea is served, "from half-past three to four," each girl being allowed 15 minutes from her desk.

In proposing such a change in plant procedure it is just as well to ask employees whether they desire to have rest periods, and if so, whether they will conform to the plant regulations surrounding them. Obviously if there are to be regular rest periods there must be a limit to rest at other times, and the stopping and resumption of work must be prompt and punctual. These can hardly be attained unless the plant discipline is good. One company, without any previous warning, issued this notice, "Production must be increased; quality must be improved. Beginning tomorrow, operations will be suspended twice daily to allow operatives to rest." This is a startling statement to workers who do not know that by periodic rests production may be increased. In plants where persons have been chosen with care both by the employment department and the doctor it is possible that physical homogeneity make the establishment of the same rest period desirable for all.

The National Industrial Conference Board finds several objections to rest periods. They are unnecessary in some jobs because the work is intermittent or because of the shortness of the working day. A German writer claims that a shorter working day with intense work secures a greater output than a longer day with rest pauses. Such a subject is a matter for investigation by an employer who desires to find out where he stands. Where the process is interrupted, as in the congealing of glue, rest periods are inadvisable unless the work is very strenuous, in which case it is possible to give consecutive rest periods by means of an additional employee. Where there is a lack of rest-room facilities the rest period may be alternated for different groups of workers. Piece-workers object to rest periods on the grounds that it reduces production. If they cannot maintain their production with the rest periods thrown in it would appear that they are unnecessary and should be abandoned. It may be said, however, that a test of only a week or two is too short to show any definite result. In the meantime piece-workers might be guaranteed for the loss of time taken in the experiment.

It is not easy to estimate the effect of rest periods. Most employers have introduced them "on general principles" and have made no effort to determine their effect on production. C. L. Pool, in *Factory* for August, 1918, relates how a five-minute recess at the end of each hour increased production 65%, but this is an isolated instance. The British Industrial Fatigue Research Board has reached the conclusion that in spite of shortened work hours the output is increased by rest pauses. In the assembly of bicycle chain parts on pendulum presses a comparison was made of output before and after the institution of rest pauses, seven pauses of five minutes each in the day. Assuming that a six-week test of output before the use of rest periods was normal, after the introduction of rest periods the daily output increased immediately and steadily, reaching in 24 weeks a fairly uniform level 13% higher than in the period preceding in spite of the fact of a loss of 7% of the working time through the adoption of the pauses.

The principal advantage to be looked for in rest periods is reduction of fatigue and consequent increase of output. Even if output is merely maintained there is still an advantage since fatigue is reduced. The provision of recognized periods when workers can loaf unrestrainedly tends to relieve tension between the foreman and the worker and to make the latter work harder and more constantly. Concentration on work due to these periodic reliefs probably tends to prevent accidents and on the whole makes employees take a livelier interest in their work.

REST-ROOMS

Rest-rooms are found to be useful for female employees, and may be used during lunch hour and rest periods and in case of emergency. They apply to plants where the work is hard, the hours long, or for persons whose presence is needed over long hours.

Such rooms are an adjunct to or part of the lunch room and may be used as a headquarters for the matron who gives out rubbers or umbrellas on wet days. Sometimes, in order to economize space, the rest-room is used for committee meetings, lectures, or dancing. Most companies nowadays employing women provide a rest-room; they are used by about 30% of the employees each day, mainly at the lunch hour.

Telephone girls, dictaphone operators, department store girls, soap wrappers, and female machine workers who get 15 minutes for resting find such rooms useful. They are not, however, of much use for piece-workers or for occupations where the worker has intermittent periods of rest at work. In some places the rest-room is always open during working hours; in others it is open during lunch hour and during the last working hour of the day and is, in consequence, available at other times for other purposes. Indisposed workers have an alternative in the provision of a couch in the first-aid room.

The rest-room is provided with comfortable chairs, partitions to separate couches from seats, and tables for books, magazines, papers, and writing materials. In convertible rooms there is a piano or victrola.

SEATING

Of all the aids to production, seating, perhaps, has received least attention. There was a time when seating was supposed to be inconsistent with work, and its existence in the shop was not even recognized. But this condition is changing because women are being employed in greater numbers and it is found that unsuitable seating causes fatigue, fatigue causes bad posture, and the latter leads to lowered production, deformities, and lost time. In a survey of 20 stores one of the most evident hygienic faults was unnatural seating.[1] This is not an infrequent condition in industry; it being still firmly held by some employers that it is impractical to provide seats for workers in certain occupations. However, "Fatigue caused by effort is natural and unpreventable; but that caused by physical discomfort is unnecessary and can be greatly minimized if not practically eliminated. This can be accomplished chiefly by studying and correcting factory seating and also the benches in conjunction with seating. Of all the causes of fatigue . . . seating is probably of the greatest importance because it is the most direct. It might be classed as one of the greatest single deterring influences on maximum production." [2] There is an intimate relation between posture and seating; the latter, indeed, being mainly an aid to correct posture which is described as, "that position of the body which makes it possible for a person to do work, day in and day out, with no useless expenditure of energy, permitting normal functions of all organs of the body." There is ample proof that seating is a crucial factor in maintaining the proper posture and in providing an alternative to those who are forced to stand at work. Change from sitting to standing, and the reverse, is quite as important as the maintenance of correct posture in either position.

Physical requirements demand the use of a certain kind of seat. The American Posture League, after painstaking study, has adapted and applied the following principles to various types of furniture, including factory seats:

1. The pelvic seat bones should rest in a pocket or depression in seat floor, which will sustain the pelvis in its right relation to

---

[1] Emmons, A. B., and Goldthwait, J. E. "A Work Chair," *Journal of Industrial Hygiene*, 1921, p. 154.

[2] Salomon, I. "How Correct Seating Affects Manufacturing Profits," *Industrial Management*, June, 1922, p. 327.

the spine and distribute the pressure borne by pelvis and thighs. In most chairs the seat bones of the pelvis bear the major part of the weight.

2. The thighs should be supported at a higher level, from the pelvis to within a few inches of the bend of the knee, pressure on which should be avoided.

3. The front edge of the seat should be rounded to avoid undue pressure on the nerves and blood vessels at the bend of the knee.

4. The back of the chair should provide space for the buttocks and their coverings, both laterally and vertically; it should sustain the spine in correct relation to the pelvis without pressure on the bony spine or pelvis; it should be properly shaped for a wide range of sizes and types of back without the need of adjustable devices.

5. The horizontal supports of the back should avoid pressure from sharp edges and should be correctly spaced as to height in relation to the shoulder blades.

6. The back support should be free from pronounced curves (hollows) in the region of the shoulders, as these are a mold for round shoulders.

7. The height of the seat should sustain to the working surface such a relation that there is room for the knee under the latter, and opportunity for the play of the arms at the elbow height.

8. The height of the seat from the floor should be such that foot-rests will give variation in height and place all in a proper relation to the working surface.

Various laws have been passed from time to time till, in 1920, 36 states required seating in both mercantile and manufacturing establishments.[1] But these laws are general in character and have had little effect since the relation between output and physical comfort has been only recently appreciated. Besides, laws, without provision for enforcement, are usually inoperative. The Labor Laws of the state of New York, amended to August 1, 1924, provide that (150) "A sufficient number of suitable seats, with backs where practicable, shall be provided and maintained.

---

[1] Hilles, Edith. "Legal Requirements Regarding Seats in Industry," *The Nation's Health,* December, 1921, p. 659.

. . . In factories, female employees shall be allowed to use such seats whenever they are engaged in work which can be properly performed in a sitting posture." Until the employer is convinced that he loses more in production by not making his employees comfortable than by providing them with seats, laws of the kind will have little effect.

The employer who desires to seat his employees with due regard for his interest and theirs is faced by a problem which necessitates something more than a casual discussion. The seating problem has three phases: seats for sitting workers, seats for standees, and rest seats, the first two in the workroom, the last in the rest-room or its equivalent. There is a difference between the working and the resting seat, the first is to enable the worker to get out production, the latter is for the purpose of enabling the worker to rest. In some occupations it will be found desirable to have seats so arranged that the worker can work either sitting or standing.

In providing seats the employer is limited to some extent by the types of seats on the market, but there has been a great improvement in the manufacture of seats in the past few years. The time is passing when the carpenter thinks of a seat in terms of wood, the machinist thinks of a seat in terms of iron, but no one thinks of it in terms of human comfort. Suiting the worker to the seat or the seat to the worker yet remains a problem. The employment office tends to standardization of the persons selected for certain occupations so that suiting the person to the seat, and the bench, is less a problem than of yore, but the employer, deterred by cost, finds it hard to procure a satisfactory seat which may be adjusted to the needs of various workers.

The present condition to be found in seating may be judged by a report made in 1923 as a result of a survey by the Joint Board of Sanitary Control, in New York.

> Of the 256 shops inspected, 214 used plain kitchen chairs as the typical factory seat. In 14 shops round stools were used, and in 63 shops, benches of the crude work-bench variety, fre-

quently covered with cloth or material of some sort, were found. In two shops folding camp chairs were used and the workers struggled with a constantly collapsing seat or back.[1]

In an investigation made by the National Consumers League of mill conditions in the Philadelphia Textile industry, in 1918 and 1919, it was found that, in spite of the Pennsylvania state law as regards seating, of the 48 plants in which this matter was carefully noted, 29 provided no seats at all; in 16 others women used boxes and bales, or occasionally a few stools scattered about. Six had properly obeyed the law, but these, with one exception, were small plants employing less than 25 women.

In the summer of 1920, 103 of the largest firms in New York State reported their seating arrangements to the Bureau of Women in Industry.

Fifty-nine of the firms were using "ordinary chairs with backs" throughout their factories. Stools, apparently without backs, were still in use in about 25 plants. . . In 14 cases it was specifically mentioned that supplies were purposely regulated in such a way as to make it necessary for those who were seated at work to rise and change their positions in order to remove the finished goods and secure new material.

It was also interesting that 11 firms reported that "since the work is piece-work, the operators can rest and change their positions whenever they wish": that they *can,* when on piece-work, is true; but, whether they *do* is quite another story. Fifteen of the firms reported a regular system of rest periods. . . . It is surprising that among these firms only 5 instances were found where seats were adjustable in any way. Eleven other firms were using seats built in different heights, but foot-rests had been considered by only 4 of the 103 plants.[2]

---

[1] Wolfson, T. "Seating Survey in the Garment Industry," *The Nation's Health,* March, 1923, p. 165.

[2] Hilles, Edith. "Practical Experiments in Seating in Industry," *The Nation's Health,* July, 1921, p. 399.

These facts are sufficient to show that much remains to be done before we have attained anything like satisfactory conditions. There is room for great advances in seating in those industries where women predominate, such as candy, laundering, needlework, tobacco, department stores, and telephone operation. No data exist as yet as to the number of persons seated and standing normally for all or only part of the day, nor of the machines which positively necessitate continuous standing and those which might be adapted to the sitting posture. Each plant interested in such facts will have to secure the information as to its own situation.

In seeking for the solution of the seating problem attention is needed as to the person, the seat, and the work, and their relation to one another. It is evident that, of the three factors involved, the seat is the most easily adjustable. Something, however, can be done in giving due attention to the selection of the worker. Obviously it will not be possible to readjust a large number of machines with the worker, but it is possible to select workers of normal height, weight, and strength, particularly if the job has been completely analyzed. Faulty posture may be due to physical impairment or to carelessness. In some plants a physical director is employed to provide calisthenic exercise as a means of correcting faulty posture, while the medical department gives health instruction indicating the value of correct carriage. The desirability of securing workers of normal physique is apparent when the inelasticity of benches and machines is considered; moreover, it may be mentioned here that overweight persons have a higher rate of mortality than those of normal weight, and the same generally applies to height. The average height may be ascertained either from the physical examination cards or by measuring the workers at the bench in any department for which seating is being considered. It will be found that the majority of persons in either sex vary little more than two inches above or below the average.

In some cases the design of the machine or the bench is faulty from a view-point of working posture and cannot easily be altered. Much can be done by new machinery considered from the view-point of human operation, and insisting that it shall be designed to meet specifications which include, above all, an easy working position. Also, the accessories, such as baskets, trays, tool stands, must be considered in relation to the worker and to the seat. A comfortable seat will not help much if the material in constant use is difficult to reach. Some machines are designed for operation at standing height. In such a case a seat should be provided to relieve the worker at intervals but at the same time to permit him to continue his operations. Such a seat should support the worker at the standing level.

Two kinds of chairs may be considered: the adjustable or the inadjustable. Of the latter, to compensate for inelasticity, several sizes may be available. An inadjustable chair, approved by the American Posture League, is made in four different heights, 16½, 17½, 19½, and 21½ inches, respectively, from floor to top of seat, with a width of 16¾ and a depth of 15½ inches. A study of the height of workers shows the number of chairs of each size needed.

The New York State Industrial Commission advocates a seat broad and not too deep, slightly saddle-shaped and with the front edge rounded; the feet resting comfortably on the floor or on a broad foot-rest attached to the floor or bench; the bench at a height to allow plenty of room for the knees between the top of the seat and the under side of the bench; no brace or other obstruction interfering with a comfortable position of the feet and legs; a back-rest supporting the small of the back and not extended up far enough to interfere with free movement of the arms; supplies arranged so that no excessive reach is involved in the work. If an operator is able to rest herself by changing her position at work occasionally, a great deal of unnecessary fatigue can be avoided. For many operations the thing to do is to begin by raising the bench and chair high enough to allow the operator to work sitting or standing.

The horizontal elevation of the seat depends primarily on the stature of the operator, the average for men being perhaps two inches higher than for women. The seat is of the proper height when it allows the sitter to feel at ease and when the body from the thighs to the knees is horizontal, with the feet resting comfortably on the floor. "We have found," says the personnel director of a large clothing factory, "that the four different heights of the chair (17, 18, 19, and 20 inches) we use have been sufficient for all but one or two exceptional cases." W. R. Basset, in discussing the effects of fatigue, mentions a case in which the production of bench workers was increased 22% by raising the height of stools two inches.

The seat should be made of wood, sloping about an inch from front to rear and slightly dished to conform to the physical structure, with the front edge well rounded. The width should be about 16 inches and the depth about 13 or more. In work that involves turning from one side to another the use of a revolving seat is desirable.

Adjustable chairs are preferable in theory to those of standard sizes. In practice adjustable chairs are very often left unadjusted. An employer's attention, being called to this fact, discovered for the first time that he had been sitting on an adjustable chair for years without ever having thought to suit its height to his own requirements! Some of this type of chair can be regulated by the worker by means of winged nuts; others necessitate mechanical help. If there is any consciousness of the value of proper seating, provision will be made for the adaptation of seating to the requirements of each individual and, therefore, the question of type hinges on cost rather than adjustability.

The chair back should conform in general to the shape of the body lines, and be upright to lend support to the back in the working position. Rest chairs may slope back slightly. Chair backs used in jobs requiring little or no arm movement may be broad, but those for chairs where arms are freely used should be small and fit snugly into the small of the back so as not to interfere with the movement of the shoulder blades. The back-rest should be adjustable and soft. It is doubtful if hard back-rests can be anything but fatiguing, since nature does not provide the spine or shoulder blades with protective cushions.

Chairs which are higher than normal and bring the feet off the floor necessitate the use of a foot-rest to make up the difference. The foot-rest should be substantial and broad enough to support the feet comfortably. If the chair seat is subject to movement the foot-rest should be adjustable. A foot-rest that does not rest the feet is a nuisance. Castors, or the less mobile metal discs, may be used on chairs subject to movement but should not be put on chairs when the work is stationary. When workers have to tend a long row of machines, chairs are fixed on rails for sliding back and forth. In this case the wheels should be ball or roller bearing since otherwise the effort of propelling the chair is fatiguing.

Variation of position is the great antidote to fatigue, hence it is desirable to arrange working benches at standing height and supply seats which bring the worker on sitting to the standing level. In this case a foot-rest is a necessity, since otherwise the legs dangle and sitting becomes tiresome. If the bench is too low for alternate sitting and standing the height can be arranged by providing a small platform adjusted to the right standing height.

In investigating the problem the first step is to ascertain the jobs that demand sitting and standing and to see whether the seats provided are satisfactory. Consultation with employees on a matter such as this which concerns them intimately is advisable. It is a not infrequent experience to find that the seats that the employer thinks satisfactory are not found comfortable at all by employees.

HEALTH MAINTENANCE IN INDUSTRY

PART V

PLANT SANITATION

XXII

TOILET FACILITIES AND SANITARY STANDARDS

Present conditions. Scope of plant sanitation. Ascertaining the sanitary needs. Functions, organization, and management of sanitation. The sanitary code. Inspection. The "Sanitary Unit" sanitary standards. Toilet-rooms: water-closets and compartments; urinals.

WHO, better than the plant physician, is qualified to administer or, at least, supervise plant sanitation? What is every one's business is nobody's business, applies to plant sanitation more than to any other plant activity. Theoretically, the plant manager is the person who sees that sanitary, as well as all other, conditions are satisfactory. In the rush for production, sanitation seems somewhat beside the direct objective and, in consequence, is apt to be neglected. The doctor, however, is professionally aware of the existence of excretory apparatus and the need for its proper functioning if health is to be maintained, and it is through his agency that sanitation should ordinarily be controlled.

The subject includes the practical application of sanitary principles to factory conditions. It has rather a wide scope in plant practice, since it is often found convenient to combine plant cleaning, and even accident prevention, with sanitation, as inspection is involved in each case. In general, however, it includes toilet and washing facilities, dressing room, lockers, laundry, and garbage disposal. Any doctor who is sincerely desirous of maintaining the health of the workers at a high level will find it to his advantage to have much to say in respect to each of these phases of the subject.

With the exception of quite modernly constructed buildings sanitary provisions are apt to be inadequate and out of date. An effort has been made in the last decade to bring sanitation in these older plants into line with modern requirements. Public attention has been aroused to the need for better working conditions and there has been an insistent demand for improvement even among the workers themselves. The existence of satisfactory plant sanitation, in itself, is an evidence of progressive management not entirely lost on the worker, who naturally seeks the plant where working conditions are agreeable and tends to remain in such a plant.

Workmen lose time when sanitation is inadequate, altogether apart from the health problem. Three minutes lost per man per day, because toilet facilities are inadequate or misplaced, in a plant with a thousand men, may cause a loss to the employer in wages of $7,000 per year which would go a long way towards the cost of adequate conveniences. Workmen often want to wash up before the whistle blows if the basins are too few in number. In some places, outbreaks of typhoid fever have occurred from impure drinking water.

Leaving sanitation in the charge of the foremen, or even department heads, has usually been an unsuccessful procedure and is tantamount to doing nothing. Decentralization has, in fact, been the leading cause of the generally low grade of sanitation to be found in some plants. Sanitary problems, regulations, and conditions are mainly technical in nature and should not be left to foremen. Their function is not to administer but to apply the established rules.

The not unusual situation is that sanitation is taken for granted and hence no one knows the exact conditions. Workmen do not complain about inadequate sanitary facilities; they are quite willing to wait patiently since the loss of time is on the employer, and if washing facilities are inadequate the men simply go home without washing or stop work some time before the whistle blows.

The first step in organizing a sanitary department is to make a survey to ascertain conditions, using, if necessary, a large-scale layout or map of the premises upon which to indicate the location and character of existing arrangements, and the relation of department and persons thereto. This is usually done by departments, each one of which may be considered as a sanitary unit. In the case of different floors each floor may be a unit. Use a symbol, letter, or number to designate each unit in case the departments are not already so identified. Ascertain present number of usable, unusable, and condemned facilities in each unit, using the following form as a guide:

Symbol	FACILITIES				EMPLOYEES		
	Name	Good	Bad	Total	Male	Female	Total
T-	Water-closets, individual						
Ti-	Water-closets, trough, length						
U-	Urinals, individual, approved						
Uc-	Urinals, individual, condemned						
Ut-	Urinals, trough, length, feet						
W-	Wash-bowls, individual, approved						
Wc-	Wash-bowls, individual, condemned						
Wt-	Wash-troughs, length, feet						
Sh-	Shower-baths						
Ls-	Lockers, steel						
Lw-	Lockers, wood						
Ch-	Chairs						
B-	Benches, length, feet						

Figure 18: Form used for recording results of a sanitary survey

The above information gives existing conditions upon which must be based any study as to adequacy as soon as the number and condition of employees are ascertained. The total "on the pay-roll" is no indication of the number to be supplied with toilet facilities. It is necessary to know the average number of workers in attendance, the maximum number working at one time, the maximum leaving work at one time, and the number of piece-workers. The occupations of the workers may be classified as "safe" or "dangerous," since in the latter case special provisions must be made. Then, the location of the workers to each group of facilities may be considered, together with such items as race, sex, color. With these facts now in possession and with legal requirements in mind it is possible to apportion facilities. In making apportionment it is necessary to recollect that the number of employees varies and also that provision should be made for future expansion. Assignment of facilities should then be made on the following bases:

Water-closets, on the basis of 5% of the maximum number working at one time;
Urinals, on the basis of 5% of the maximum number of males working at one time;
Wash-bowls, on the basis of 50% of the maximum number of workers leaving at one time;
Showers, on the basis of 1% of the maximum number leaving at one time;
Lockers, on the basis of one for the maximum number working in each department;
Bubblers, on the basis of 5% of the maximum working at one time.

This apportionment generally exceeds state requirements, with which, however, they should be checked. Special conditions often necessitate modifications. Lead burners, workers in alkali, acids, and other poisons will require a larger percentage of showers, while men in other departments may need less. Then, there is the question of space. Sometimes there is hesitancy in installing more than the strict legal requirements only to find that the growth of the plant soon absorbs the margin. The possible growth of the plant, on the basis of past experience, should be anticipated at least in so far as space is concerned; further installations may then be made as needed.

In most plants, where there is a consistent effort to maintain sanitation at a high standard, the plant physician or the personnel director has charge. Some doctors have not specialized in plant sanitation, but at the worst they are more competent to handle the problem than any one else. In the very large plants it is desirable to have one person with special sanitary training. In the smaller plants sanitation will fall to the employment manager for inspection and the doctor for supervision. In some cases, as, for instance, in the Youngstown Sheet and Tube Company, sanitation is combined with safety for the reason that sanitary and safety inspection can be made at the same time. In all cases the doctor supervises.

The main functions of the sanitary department are standardization of sanitary facilities; supervision, inspection, and education. The first step is the adoption of definite sanitary standards; the second is to put them in force. Sanitary standardization is now an accepted policy not only in the larger plants but in those corporations which have widely scattered units. The advantage in the case of the large organizations is obvious. Instead of having 20 corps of engineers prepare plans according to limited ideas, the central organization prepares the plans absorbing the best ideas of the smaller plants. The Standard Oil Company of New Jersey issued such standards to all its constituent plants in 1918 to govern in the purchase and installation of all new sanitary equipment for the use of wage-earners. About the same time the United States Employees' Compensation Commission issued federal standards for toilet, wash-rooms, and locker-rooms as prepared by the Bureau of Standards in conjunction with the safety engineers of federal industrial establishments. Similarly the National Safety Council, in its Safe Practices Number 27, covers much the same range of topics. The earliest effort towards standardization was made by the United States Steel Corporation, which issued instructions in November, 1913, and the principle was adopted by the B. F. Goodrich Company under the leadership of W. N. Fitch. Finally the United States Public Health Service, with the cooperation of the American Engineering Standards Committee, has in preparation an Industrial Sanitation Code, which may be adopted by any industrial establishment or adapted to its needs.

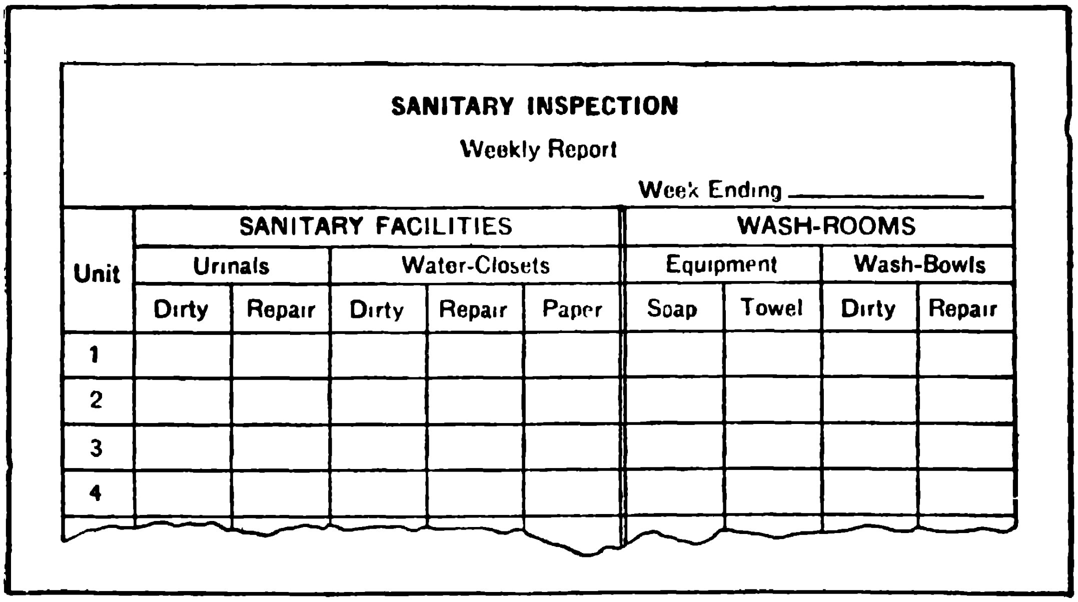
The purpose of such codes is to provide a means whereby persons interested in the problem of plant sanitation are enabled to follow the best obtainable practice without the need of making special investigations. The plan is applied, in the case of sanitary facilities, by purchasing and erecting no new facilities except according to the specifications. In course of time, without any radical expense, the whole sanitary apparatus of the plant becomes modernized.

The application of such standards remains a dead letter unless some one is given authority to direct and regulate their installation. The sanitarian's duty is not only to see that the existing facilities are gradually replaced when unsatisfactory, but also to see that they are maintained at as high a grade of cleanliness and use as possible. He must further be prepared to give expert assistance to each department head on sanitary matters and instruction to employees in the usage of toilet facilities.

In the purchase of water-closets, urinals, wash-bowls, or lockers nothing but the most substantial, and generally the most costly sanitary equipment is economical in the end. Factory "seconds" in the case of water-closets, urinals, and wash-bowls are quite suitable for factory use, the only blemish as a rule being a slight discoloration.

A further point, and one most important, if economy is to be obtained, is that no new buildings should be planned without making provisions for sanitary accommodations for the workmen who will be engaged in their operation after completion. Where buildings are erected in units, as in the case of furnaces, stills, it is known that a certain definite number of persons will be needed to operate them and it is only mere common sense to make the necessary accommodation for them when the plans are drawn and not put them in as an afterthought. It is the sanitarian's duty to anticipate the sanitary needs of the workers in such cases and he should be given power to inspect all new plans to see that they fulfil the standard requirements.

Efficient sanitary inspection demands the establishment of a definite plan, the use of an inspection form, and a means of reporting unsatisfactory conditions. The sanitary accommodations are mapped out by departments or units, each unit being numbered consecutively in the sequence to be followed in making the periodic inspection. The units themselves are also numbered or identified by the department name and within the units are also numbered each water-closet, urinal, and locker for the purpose of identification. The inspector makes a weekly tour and, by the use of a sanitary inspection form, notes unsatisfactory conditions. In addition he has a repair requisition form to be used in notifying the department head when facilities are out of order, retaining the duplicate for reference. The weekly inspection form is then sent to the head of the department.



SANITARY INSPECTION

Weekly Report

Week Ending ____________

Unit	SANITARY FACILITIES					WASH-ROOMS			
	Urinals		Water-Closets			Equipment		Wash-Bowls	
	Dirty	Repair	Dirty	Repair	Paper	Soap	Towel	Dirty	Repair
1									
2									
3									
4									

Figure 19: Form used for weekly report of sanitation inspection

Workers are not infrequently ignorant of the proper care and use of water-closets, and wash-bowls. They are apt to strain the faucets, clog the pipes, and put coarse paper in the water-closet bowls. They need a little instruction and particularly in the case of new installations. It is a mistake to ascribe to maliciousness what is often caused by ignorance.

In designing plant sanitation the formation of a sanitary unit is sometimes advantageous. This unit, founded on definite sanitary standards, can be made to accommodate a certain number of men. In those places where small groups are scattered over a wide area or where there are gangs attached to series of furnaces or other recurring operations, the plan is useful. Whether it is more costly to have small or large units depends on the layout of the plant. Generally speaking the cost of construction decreases with the increase of size, but this is offset by the time taken by men to go to the larger unit.

A "sanitary unit" for 24 men consists of two rooms, in the first of which are three wash-basins, one shower-bath, one water-closet, and one urinal. In a room adjoining are 24 lockers and two benches. The unit thus provides ample accommodation and may be modified as circumstances demand. Thus, in some operations a shower-bath is unnecessary and the space may be used for an extra water-closet. In cases where there are three shifts the same layout may be used, except that lockers shall have to be provided for three shifts instead of one. The unit should be based on the size of the prevailing group of workers and, of course, will need modification in the case of females. The unit may be doubled or tripled as needed and it is highly desirable to provide accommodations in conformity with the structural design or layout of the department.

SANITARY STANDARDS

The following sanitary standards have been used by a large corporation for several years both as a guide in purchasing new, or replacing old, equipment.

Toilet-Rooms, Wash-Rooms, and Locker-Rooms

General. Wash-rooms, toilet-rooms, and locker-rooms to be provided for all employees, at points throughout the works, easy of access to employees and in groups of three separate rooms, preferably adjacent, witn doors between. If necessary, the toilet-rooms may be installed in separate location.

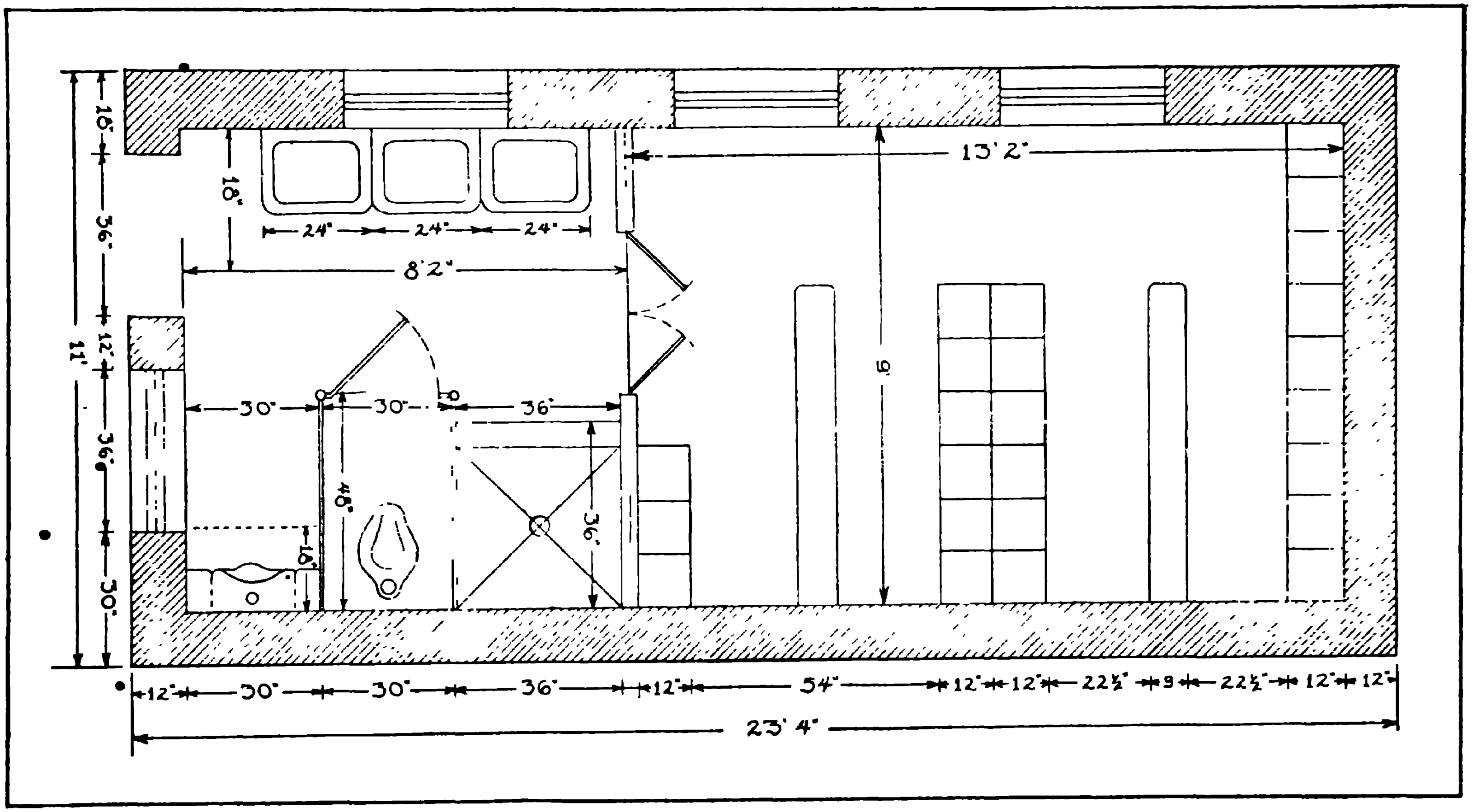


Figure 20: Standard sanitary unit for the accommodation of small groups of workers

TOILET-ROOMS

Floors. Floors to have a substantial concrete base slab finished with 1:2 cement and sand, troweled smooth, and painted with light gray or brown concrete floor paint. Josam "Government" type combined trap and drain, or equal, floor drains to be installed to permit washing of floors.

Wainscot. Walls to have a 5-foot high wainscot of 1-inch thick American or English size enamel brick seconds, with sanitary cove base. Ogee return on top and bullnoses around window openings. Enamel brick to be laid up against rough cement plaster and to be buttered with mortar consisting of 1 part Portland cement, 2½ parts fine screened sand, and ½ part well-slaked lump lime (do not use hydrated lime if it can be avoided). Joints to be ⅛ inch wide and racked to a depth of ⅛ inch, which, when set, are to be filled with white Atlas cement grout and struck flush. White sand may be added for joints wider than ⅛ inch in a proportion of 1 part Atlas white cement and 1 part fine-screened white sand.

All enamel brick, before laying, must be soaked in water until thoroughly saturated.

Walls and Ceilings. Walls, above wainscot, and ceilings shall receive a rough coat of cement plaster and a finish coat of Keene's cement plaster applied in ⅛-inch thickness, carefully worked and troweled smooth to avoid cracks or open spaces.

To keep walls clean they may be washed or coated with white calcimine.

Windows. On new installations every toilet-room or every water-closet or urinal compartment shall have a window opening directly to the out-door air. All window sills to be no less than 5 feet from floor, and no window shall be less than 1 foot wide nor have an area of less than 6 square feet, measured between stop heads, for one water-closet or urinal. For every additional such fixture, the area of such window shall be increased at least 1 square foot. A skylight shall be deemed the equivalent of a window, provided that it has fixed or movable louvres with openings of the net openable area prescribed for such window.

Every such window shall open upon a street or upon a yard or open space, uncovered at the top, which in its least horizontal dimension shall be one-tenth the height of the highest abutting wall but in no case less than 6 feet.

Ventilation. All toilet-rooms not lighted by windows that open easily shall be adequately ventilated to the outside air by arti-

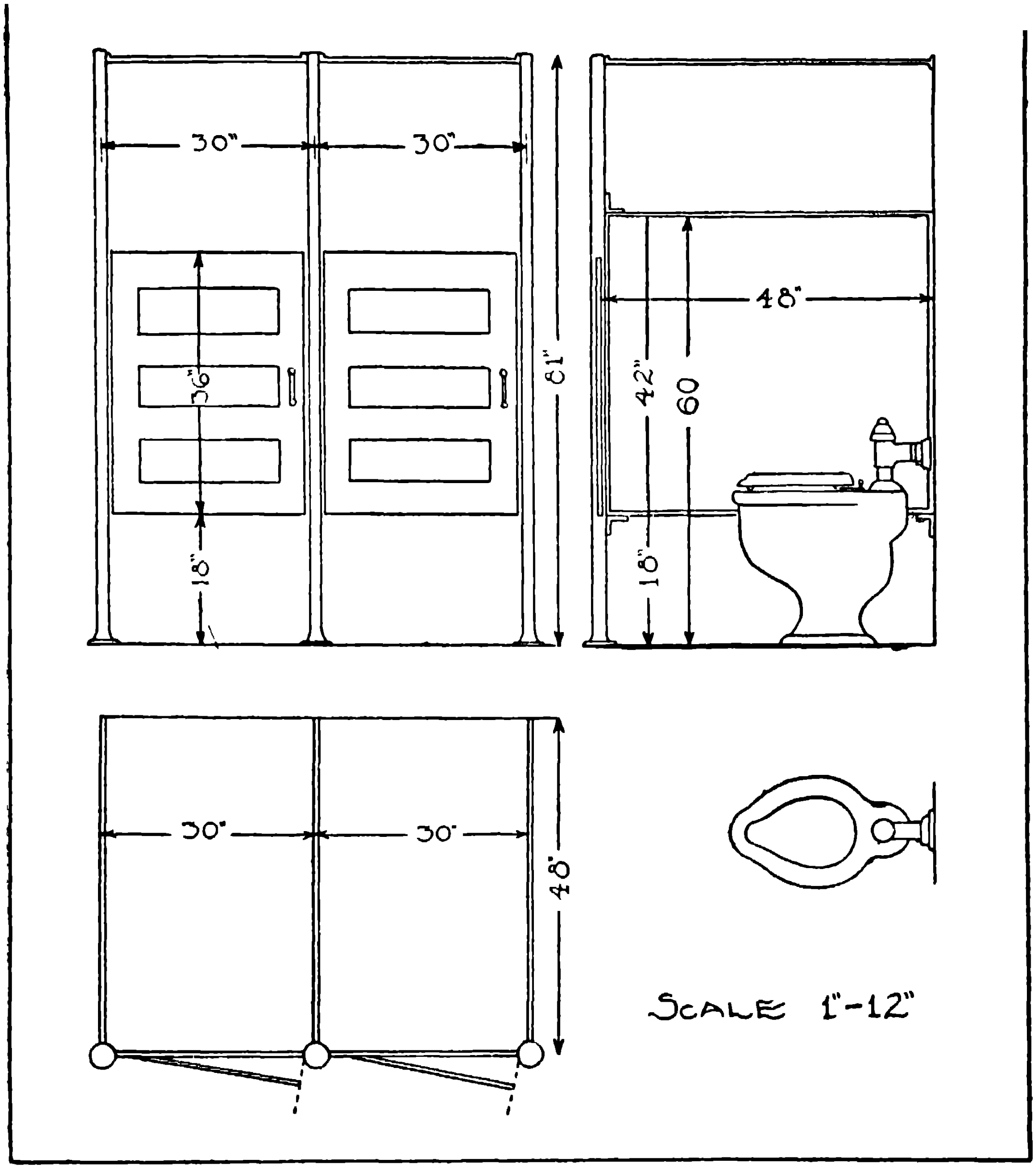


Figure 21: Water-closet compartment

ficial means. Every water-closet compartment entirely separated from the remainder of the toilet-room by partitions extending from the floor to the ceiling and not provided with a window opening easily, shall be adequately ventilated to the outside air by artificial means.

Make of ventilators recommended will be found under heading "Ventilators."

Screening. The entrance to all toilet-rooms shall be provided with a screen to ensure privacy. This screen shall be at least 6 feet in height, and shall extend to within at least 4 inches of the floor and, if the space permits, shall be not less than 2 feet wider than the door leading into such toilet-room.

Water-Closets. White vitreous china, silent action syphon jet closet with top inlet and floor outlet, 2-inch brass spud, extended front lip and cut-back rim, finished all the way around. Height 14½ inches, opening of bowl 16 inches, water surface 14 inches

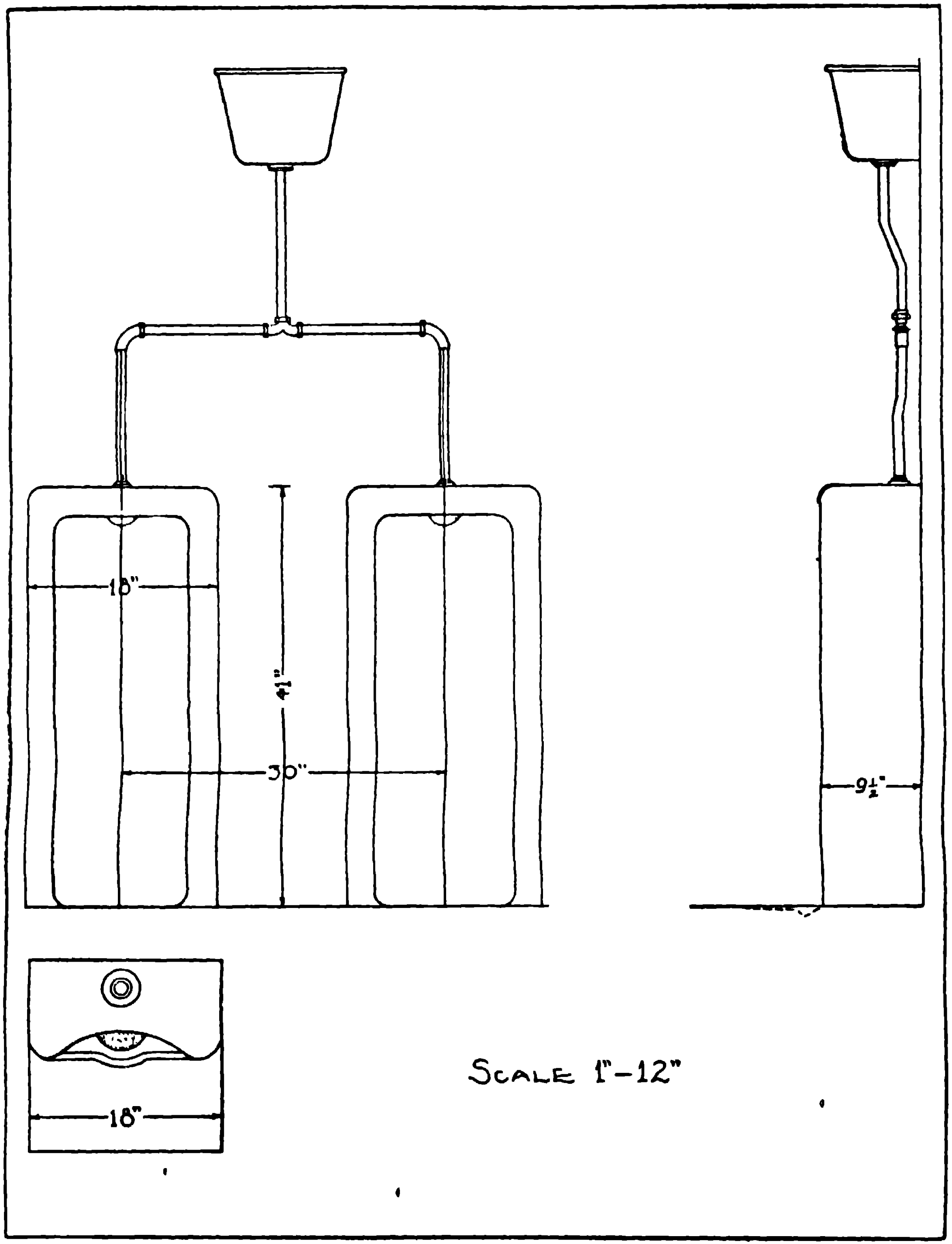


Figure 22: Plan showing urinal installation

by 10 inches, sanitary rim with 1¼ inches downward projection inside of bowl, water seal 3 inches and trap opening conforming with government specifications.

Each closet to be furnished with Brunswick-Balke-Collender Company's, or equal, Number 18-5 ebony "Whale-Bone-Ite" closet seat, open front and back, having nickel-plated special heavy hinges; also Sloan Valve Company's, or equal, nickel-plated, predetermined flush, Number 9 "Royal" flush valve with Style "H-R" stop and necessary mechanism for seat action.

The Royal flush valve will operate on any pressure from Number 5 up, provided the proper volume of water is supplied. To ensure this, the Sloan Valve Company, of Chicago, will furnish free of charge a piping diagram giving the proper sizes, upon receipt of a sketch or plan giving: (1) Number and location of valves; (2) Pressure at water main; (3) Distance from water main or tank to flush valves.

Strainer. Where salt water is used for flushing closets and urinals, a strainer is to be connected into supply line to prevent grit and dirt from reaching mechanism of valves.

Stalls. Closets to be installed in single or double rows. Stall partitions to be cast iron, painted, for toilet-rooms located under condenser boxes or at such point where exposed to the corrosive action of gases, and so forth. Pipe stations and braces for stalls to be painted.

In toilet-rooms not exposed to gases, stall partitions may be made of sheet metal, painted, or ⅞-inch slate. Pipe stanchions and braces for stalls to be nickel plated.

Stall partitions to be 30 inches wide, 48 inches deep, 3 feet 6 inches high from top of standard, 5 feet high from floor, and to be provided with wood or metal doors 36 inches high, 18 inches above floor. Each stall to be equipped with two nickel-plated coat hooks and a toilet-paper fixture of the automatic single-sheet feed type.

Number and Ratio of Water-Closets. For toilet-rooms designed to accommodate the number of employees indicated:

When the Number of Employees Is	Supply One Water-Closet per
1 to 15	5 employees
15 to 40	10 employees
40 to 100	20 employees
100 to 500	30 employees
500 to 1,000	35 employees
1,000 to 5,000	40 employees

Urinals. Porcelain urinal stalls, 1 foot 6 inches wide, 3 feet 5 inches high, 9½ inches deep from face to back, with vitreous automatic flushing cisterns, with nickel-plated brass brackets, spreader and inlet coupling and brass waste plug and coupling with removable brass grating and nickel-plated flush pipe.

One flush tank to supply not more than three urinals.

Each urinal to have an individual non-syphoning lead clean-out trap, with threaded brass cover, set flush with raised floor. Traps to be located between urinal stalls, to make them readily accessible, but far enough back of standing platform to avoid their forming an obstacle.

Spacing and Setting Urinals. Urinals to be spaced not less than 30 inches from center line to center line, and to be set with top of lip 3 inches above main floor line, the entire floor around urinals, which is to extend 30 inches from rear of urinals and across battery, including space between stalls, to be 3 inches above main floor line. The raised floor to pitch toward and to be flush with lip of urinal and to be 1 inch hexagonal white tile ¼ inch thick, laid according to Tile Setters' Specifications, or "Smooth-on" finish as per Specification "A" in Smooth-on Manufacturing Company's pamphlet Number 7. Floor in space between urinals to be laid on a slope of 4 inches in 12 inches, pitching forward. Stop for raised floor to be 4 inches thick concrete curb.

Number and Ratio of Urinals. For toilet-rooms designed to accommodate the number of employees indicated:

When the Number of Employees Is	Supply One Urinal per
1 to 15	7 employees
15 to 40	15 employees
40 to 100	25 employees
100 to 500	35 employees
500 to 1,000	50 employees
1,000 to 5,000	75 employees

Cleanliness. A janitor shall be held responsible for the maintenance of all toilet-, wash-, and locker-rooms, including water-closet compartments, in a clean and sanitary condition.

WASH-ROOMS

Floors, Wainscot, Walls and Ceilings, Windows, Ventilators, Lighting, Heating, Drains. Same as specified for toilet-rooms,

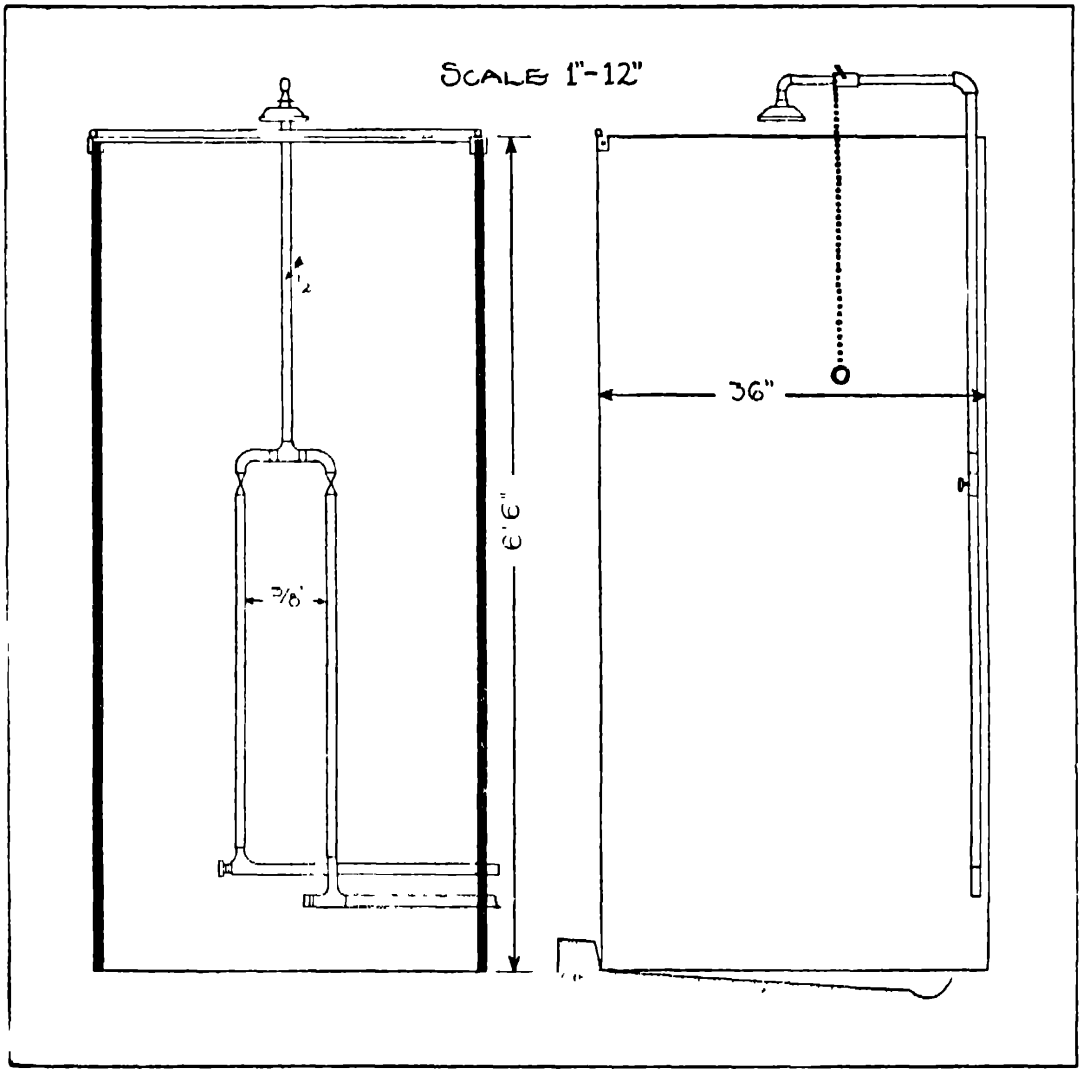


Figure 23: Shower-bath compartment

except walls and ceilings to be painted with light color, washable oil paint instead of calcimine.

Wash Sinks. Standard Sanitary Manufacturing Company's plate P-6457 wash sink, or its equivalent, 30 inches by 6 feet, enameled inside, with exterior sprayed with white enamel; rim of sink to be 31 inches from floor; supported on two porcelain enameled iron pedestals and fitted with two 18-inch double iron supply pipe supports sprayed with white enamel; with two ¾-inch rough nickel-plated brass supply pipes, each having three rough nickel-plated brass double faucet connections, right- and left-hand threaded and arranged so that the hot water is at the left-hand side of all faucets; with six rough nickel-plated brass, rose-spraying (with Number 52 drilled holes), double-mixing, quick-pression faucets, with nickel-plated beehive strainer and

1½-inch nickel-plated cast brass "S" trap, without plug or stopper, fitted with six rough nickel-plated brass soap dishes. All fittings to be attached in such manner that easy removal of same is made impossible.

For wall mounting use 13¼ inches wide inside by 6 feet long wash sinks, with 8-inch high integral back, plate P-6451, fittings and finish to be as specified above.

Warm Water Supply. Warm water is to be supplied to washstand faucets by means of Powers Regulator Company's, or equal, thermostatic steam and water mixer, as shown in Powers Regulator Company's Bulletin Number 137. These mixers furnish warm water at a temperature of 120 degrees and are to be installed in the following proportion:

25 G.P.M. capacity mixers for 18 faucets or less
40 G.P.M. capacity mixers for 30 faucets or less

It should be understood that with these mixers the steam pressure must be at least 25 pounds higher than the water pressure to insure proper heating and volume of delivery. Further, steam pressure should in no case be more than 125 pounds.

Number and Ratio of Faucets. For wash-rooms designed to accommodate the number of employees indicated:

When the Number of Employees Is	Supply One Faucet per
1 to 15	2 employees
15 to 40	3 employees
40 to 100	5 employees
100 to 500	8 employees
500 to 1,000	10 employees
1,000 to 5,000	15 employees

Showers. Shower heads to be 5 inches diameter cast brass, nickel-plated rain shower heads with adjustable ball joint and self-closing controlling valve with nickel-plated chain pull and ring. Mixing column to be ½-inch nickel-plated brass pipe; supply pipes to be ⅜-inch nickel-plated brass from mains up, with ⅜-inch, 4-ball, china indexed handle, swivel disc compression cocks. The horizontal supply mains to be nickel-plated brass pipes and nickel-plated brass fittings, of sufficient size to take care of number of showers in a battery. All fittings to be attached in such manner that easy removal of same is made impossible.

Stalls. Stalls to be made of slate, not less than ⅞ inch thick. Dimensions of stalls to be 3 feet by 3 feet. Height of backs and partitions from floor up to be 6 feet 6 inches. Partition slabs to be supported on self-contained slate legs 6 inches wide; remainder of partition section to be cut away to a height of 12 inches from floor line, to permit flow of water (see sketch). End partitions to be full. Partitions to be secured to backs by means of nickel-plated brass angle clips and to be braced in front by means of 1¼-inch nickel-plated brass tubing. The floor of the shower stalls to be sloped to the back ½ inch in 12 inches and to be made of 1 part cement and 2 parts sand finish, troweled smooth and water-proofed if necessary. A concrete trough is to run in rear of shower stalls, with drains in each five stalls, drains to be Josam "Government" type combined trap and drain, or equal. A 4-inch wide curb wall is to be run around shower enclosures, 4 inches above floor line, to keep water within shower stalls. A wood floor mat is to be furnished for each shower compartment. Comfortable wood benches and a sufficient number of clothes hooks shall be provided for each battery of showers. Rough nickel-plated brass soap dish to be mounted on partition of each stall at a height of 4 feet from floor line.

Warm-Water Supply. Warm water is to be supplied to showers by means of Powers Regulator Company's, or equal, thermostatic steam and water mixer, as shown in its Bulletin Number 137. These mixers are to be installed in the following proportion:

25 G.P.M. capacity for five showers or less
40 G.P.M. capacity for ten showers or less

Wherever practicable and construction permits, the shower stalls are to be faced with openings toward wall, leaving an aisle between stalls and the wall, to give more privacy to bathers, cutting off the view from employees using wash stands.

Number and Ratio of Showers. For wash-rooms designed to accommodate the number of employees designated:

When the Number of Employees Is	Supply One Shower per
1 to 15	15 employees
15 to 40	15 employees
40 to 100	20 employees
100 to 500	30 employees
500 to 1,000	40 employees
1,000 to 5,000	50 employees

LOCKER-ROOMS

Same specifications as toilet-rooms, except no enamel brick wainscot; therefore floor finish is to be worked against walls to form a two-inch radius sanitary cove flush with finished plaster line.

Lockers. Each employee to be provided with one Durand Steel Locker Company's, or equal, louvered door, slanting top, steel locker 18 inches wide, 15 inches deep, 70 inches high. Lockers to be equipped with steel angle legs 16 inches high, and steel supports to permit the placing of a bench board 10 inches wide immediately against and running along front of lockers, at the same time allowing the door to be opened without interference of the bench in front of same.

All lockers to be furnished with padlock or other substantial lock, chain, clothes hook and pulley, for hanging dirty working clothes immediately above lockers (see sketch), or separate locker compartment for working clothes, and all employees to be forbidden to hang working clothes in lockers with street clothes.

In ordering, number of lockers in row must be specified, as this will govern location of bench supports. Height from floor to ceiling must also be stated.

DRINKING FOUNTAINS

Drinking water faucets shall be of such design and construction as to obviate the direct application of the lips to the water outlet, and are to be installed as rapidly as practicable, in convenient locations.

Standard Sanitary Manufacturing Company's Plate D-4279 sanitary bubblers, or equal, with self-closing compression faucets, are recommended.

Water to be refrigerated in the summer and tested periodically by chemical and bacteriological examinations, and filtered when necessary.

Ice used for cooling purposes shall be applied in such a manner that the ice itself will not come in contact with the drinking water, and the water from the melting ice will not become mixed with the drinking water.

Water receptacles shall be thoroughly cleansed weekly and then sterilized with steam or with boiling water.

Employees engaged in the care and maintenance of drinking facilities shall be determined to be free from communicable diseases by physical examination.

SOAP AND TOWELS

Company to supply a limited amount of soap without charge, all employees to supply and care for their own towels.

GENERAL CONSTRUCTION DETAILS

Ventilators. Swartwout Rotary Ball Bearing, Auto-Force, Globe, Burt or Royal ventilators may be used, of size necessary for effective and satisfactory ventilation. Ventilators must be equipped with damper so that during extreme cold weather they may be shut off if necessary. Glass-top ventilators may be used where light is desired. Each ventilator is also to have a copper, bronze, or Monel metal netting (20 mesh, Number 33 wire) covering opening, to keep out flies and mosquitoes. The kind of metal to be specified for mosquito netting is subject to local conditions. In all cases the most durable metal is to be used for each particular installation, depending on gases and fumes to which it is exposed.

Window and Door Openings. All window and door openings in toilet-, wash-, and locker-rooms to be provided with copper, bronze, or Monel metal mosquito netting (20 mesh, Number 33 wire). The kind of metal to be specified for mosquito netting is subject to local conditions. In all cases the most durable metal is to be used for each particular installation, depending on gases and fumes to which it is exposed.

Water Lines. All water lines, whether for flushing or washing purposes (whether salt or fresh water), shall be cast iron B. & S. pipe, coated, for large sizes, and galvanized wrought iron pipe for small sizes. The use of plain wrought iron pipe shall be discontinued, as it will cause rust stains on toilet and lavatory fixtures.

Sewers. All sewers from lavatory and toilet fixtures are to be properly vented to the atmosphere to insure a rapid flow-off and to avoid syphoning of traps.

Hot-Water Supply and Regulators. The Powers Regulator Company's thermostatic steam and water mixers, herein specified for wash sinks and showers, heat water direct to a temperature of 120° and are safe against scalding. Where, however, other hot-water heaters are now in use and their use is to be continued in connection with these standards, one of the following devices is to be installed as a matter of safety precaution:

Powers Regulator Company's, or equal, thermostatic water controller to be installed in hot-water line supply to sinks and showers to prevent scalding. As shown in Powers Regulator Company's Bulletin Number 124.

Powers Regulator Company's, or equal, Number 11 regulator, as shown in Bulletin Number 129, is to be installed in hot-water boiler proper and set to keep temperature of water below scalding point.

Revision. These specifications are subject to revision in accordance with state or municipal regulations.[1]

TOILET-ROOMS

The universal, though incorrect, name of rooms containing water-closets and urinals is the toilet-room and the usage has legal sanction, for the New York State Industrial Code defines a toilet-room as, "Any room containing more than one water-closet or urinal or containing one or more water-closet compartments." Care should be exercised in locating toilet-rooms, it being recollected that the worker makes two visits a day on company time. They should be as near the large mass of the workers as possible, either at the middle of the long side of the building or sometimes on balconies near the work in the case of one-story buildings. In multistory buildings males and females are accommodated on alternate floors. When toilet facilities are combined with wash-rooms the whole might be placed somewhat on the line of travel between the gate and the work but as near to the place of work as possible.

In planning the construction of toilet-rooms due care should be given to permanence, ventilation, and cleanliness. Unless the construction is solid, toilet-rooms get out of repair, look shabby, and become dirty. The floor is of concrete, free from cracks, and covered with a floor hardener. If the floor is to be painted it will have to be neutralized with zinc sulphate solution and then covered with a heavy coat of paint. Boiled linseed oil, thinned with gasoline half and half, is useful to make old concrete floors impervious to water. By slightly pitching the floor, good drainage is provided so that the floor can be swabbed out daily with ease. Valves may be placed above floor and against wall for flushing with either hot or cold water in lieu of which a rubber hose attached to the faucet may be used.

---

[1] "Industrial Sanitary Standards," *Safety Engineering*, pp. 135-141.

All corners and bases should be coved so as to prevent the accumulation of dirt. The walls may be covered to a height of five feet with white enameled brick seconds and the upper part may be finished with hard plaster and painted light oil color. The ceilings are whitewashed or painted with a light-colored flat oil paint.

The toilet facilities should be ventilated to outside air by windows six feet in area for each water-closet and the windows should be screened in summer, and preferably of the horizontal opening type, provided with sash operation.

There should be vestibule doors at entrance to washroom, and swing doors between rooms with glass panel inserts at eye level. All parts of the rooms should be easily visible during working hours; artificial light should be provided when daylight is insufficient, and it should be sufficient for cleaning at night. The approaches should be well lighted.

During working hours toilet-rooms should be heated to at least 50 degrees Fahrenheit during the winter months and from 55 to 65 at other times. A thermometer fixed on the wall 5 feet from the floor and away from direct heat or window may be used to check up the heat of the room from time to time.

Proper natural ventilation should be supplied by means of windows of ample area, no less than 6 square feet per water-closet and for every additional fixture at least one additional square foot, a skylight being considered equivalent if it is of the same area. Mechanical ventilation is permitted as an alternative if it has a capacity of 35 cubic feet per minute, or 25 when exhaust is within 2 feet of fixture.

Toilet-rooms should be kept constantly cleaned and one attendant to about 40 men is sufficient for the purpose. In the Gisholt Machine Company a check list is kept of men entering toilet-rooms and the length of time spent there; defacement or damage can then be traced easily. The attendant should be instructed in disinfection, ventilation, and maintenance by the sanitarian. Besides daily flushing of all floors, occasional disinfection is needed by the use of a formaldehyd spray or a formaldehyd solution. If the wash-rooms are not next the toilet-rooms a wash-basin should be provided in the toilet-room.

APPORTIONMENT OF TOILET FACILITIES

The number of water-closets and urinals to be supplied varies with the number of men and women employed.

TABLE 87

TOILET FACILITIES NECESSARY FOR EACH SPECIFIED NUMBER OF MEN AND WOMEN

	WOMEN	MEN	
Number of Employees	Number of Water-Closets	Water-Closets When Urinals Are Supplied	Number of Urinals
15 and under	1	1	0
35 and under	2	2	0
55 and under	3	2	1
80 and under	4	3	1
110 and under	5	4	1
150 and under	6	4	2
190 and under	7	5	2
220 and under	8	5	3
250 and under	9	6	3
280 and under	10	7	3
310 and under	11	8	3
340 and under	12	8	4
370 and under	13	9	4
400 and under	14	10	4
430 and under	15	10	5
460 and under	16	11	5
490 and under	17	12	5
520 and under	18	12	6
550 and under	19	13	6
580 and under	20	14	6

Table 87 gives the minimum requirements according to the New York State law.

WATER-CLOSETS

In some places water-closet compartments are not used, but it is generally necessary to enclose each water-closet in a compartment. This should be 2½ feet wide, 4 feet deep, and contain about 200 cubic feet of air space. The compartment doors should be made of impervious material, usually wood painted in oil, though metal doors may also be used. The doors should be 30 inches high and 24 inches from ground. There is a clothes hook on each compartment partition or door, the latter being provided with a self-closing device.

In rooms containing water-closets and urinals it is better to place water-closets around the walls and the urinals in the center to avoid cutting off the light. The use of any form of trough water-closet, latrine or sink is generally prohibited and the best practice is to have individual water-closets of the flush valve type. The latter is neat and unlikely to get out of order, having no tank valve, but it requires larger pipes and more water pressure. Seat-action valves should have a full inch and a quarter supply to each closet, the size of the main supply pipe being governed by the pressure and the number of closets. It is desirable to ascertain the amount of the water pressure before making an installation. In some cases a separate water supply is required for closet valves. Each individual closet should have a controlling stop or regulating valve and the flush should be at least three gallons.

The bowls should be of porcelain or vitreous china, with rim flush bowl separately vented and trapped, with the trap located above floor level and entirely free from all woodwork. The bowls are sold in several qualities; defective bowls are less costly and the defects as a rule do not interfere with use.

There is no occasion to provide covers for water-closet seats. They are unnecessary if flushing is effective, and inspection is easier. The seat should be 7 inches broad and 11 inches long. The split seat, composed of a left and right section, is now generally favored. It should be made of wood covered with a guaranteed varnish impervious to water, or of composition.

There should be an adequate supply of toilet paper for each water-closet; clogging of the pipes results when the container is not filled and other paper is used.

URINALS

Urinals, more than water-closets, should be provided in small units convenient to the work and at the rate of about one for 40 men. Two linear feet of slab is equivalent to one individual urinal. The floor in front of the urinal may be of asphalt, which, unlike cement, is impervious. Partitions, dividing one urinal from another, may be of slate, enameled steel or wood, preferably enameled white. Urinals should be open to outside air or as an alternative, the air may be changed eight times per hour.

There are two types of permissible urinals, the full-length individual urinal, coming flush with the floor and made of porcelain or heavy earthenware, or the individual bowl, made of the same materials. Both should be enclosed to ensure privacy except in rooms from which females are excluded. All material used in the construction should be impervious to moisture. Cast iron, galvanized iron, sheet metal or steel are inadvisable unless coated with vitreous enamel.

The floor in front of urinals should slope slightly to the drain. Each urinal should have a separate water-supplied cistern or flush valve, with not less than one gallon of water for each discharge, or water may be allowed to run continually over slabs. The water supply should be foot operated. Trough urinals are no longer allowed.

XXIII

WASH-ROOMS AND WASHING FACILITIES

Extent in industry. Plant requirements. Equipment: wash-basins; wash-troughs; wash-fountains. Washing time. Towels and soap. Cost of towel supply. Showers. Types. Water for showers. Amount of usage. Swimming pools; indoor and outdoor.

What is generally known as the wash-room is sometimes called the service building, and in the case of mining, the change house. It is generally part of, or at least adjacent to, the locker-room and consequently should be placed close to the work to avoid exposure but between it and the main entrance, and also close to the toilet facilities. It should, as a rule, be separate from the working place or enclosed if in the building. The wash-room should be located with reference to light, heat and ventilation, water and power supply.

Health and modern sanitary standards, no less than the self-respect of the worker, are sufficient reasons for the installation of wash-rooms, but the economic factor may alone justify the expenditure. "Frequently 10, 15, 20, or 25 minutes, and sometimes even half an hour, before closing time, it is the practice of men to begin washing up and to loaf in general before the whistle blows." When adequate washing facilities are provided a more rigid discipline can be enforced.

The tendency to supply liberal washing facilities is now becoming general. *Bulletin Number 250* of the Bureau of Labor Statistics reported the conditions given in Table 88, as a result of an investigation made in 1917.

Washing facilities are supplied in most plants but in many cases they are inadequate. The modern tendency is to exceed state requirements and this is specially desirable

TABLE 88

WASHING FACILITIES IN 409 INDUSTRIAL ESTABLISHMENTS, 1917

Particulars	Total
Number of establishments reporting	409
Number of employees	1,614,477
Showers	238
Troughs or sinks	120
Individual bowls	203
Soap supplied	207
Soap not supplied	146
Towels supplied	190
Towels not supplied	172
Facilities used on employer's time	187
Facilities not used on employer's time	131

in plants manufacturing food products, poisons, or in the dirty trades. Normal requirements of wash-basins, with hot and cold water, are as follows:

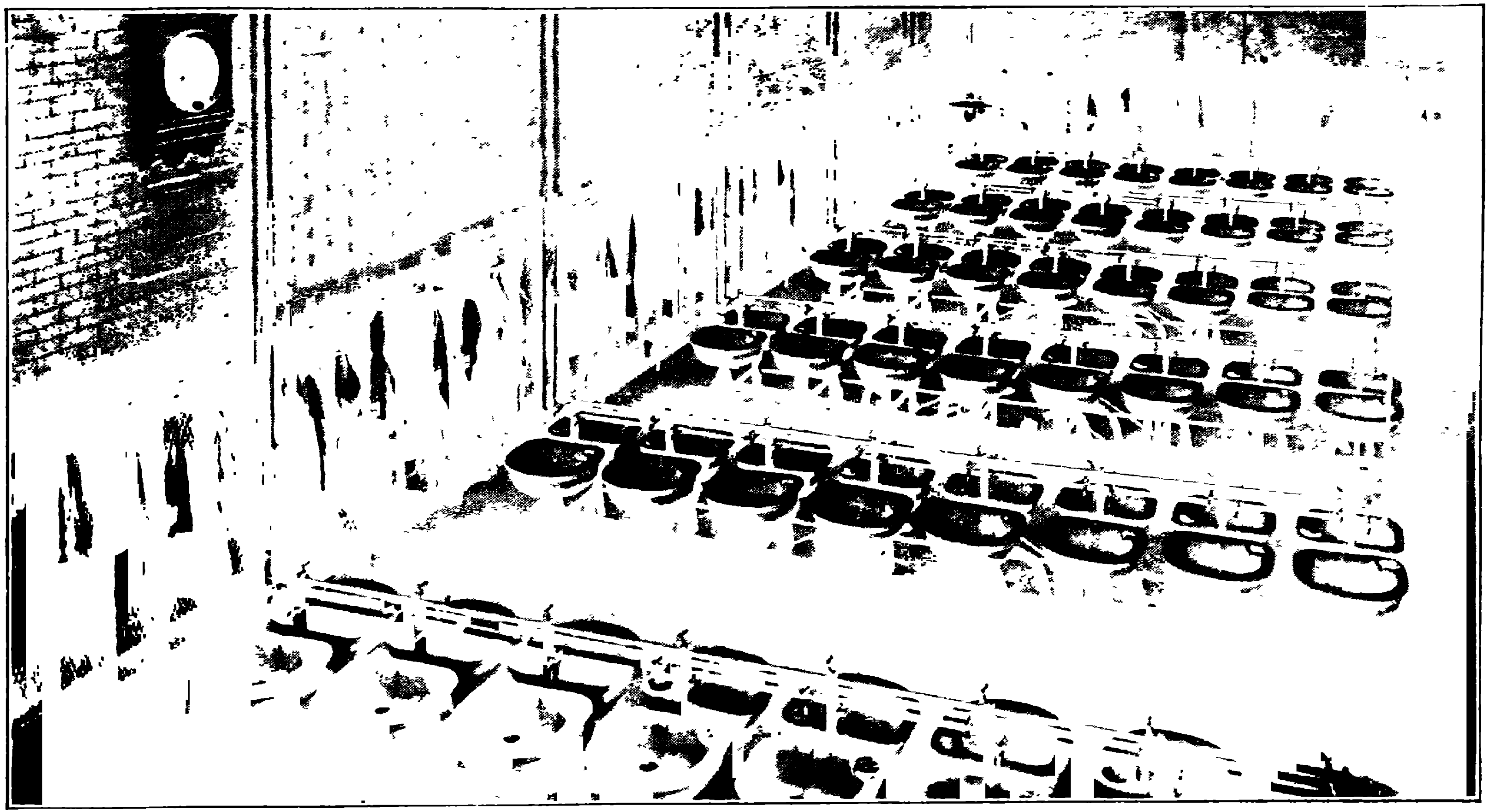
TABLE 89

REQUIREMENTS OF WASH-BASINS, WITH HOT AND COLD WATER

Number of Persons	Number of Wash-Basins	Ratio
1 to 8	1	1 to 8
9 to 16	2	1 to 8
17 to 30	3	1 to 10
31 to 45	4	1 to 11¼
46 to 65	5	1 to 13

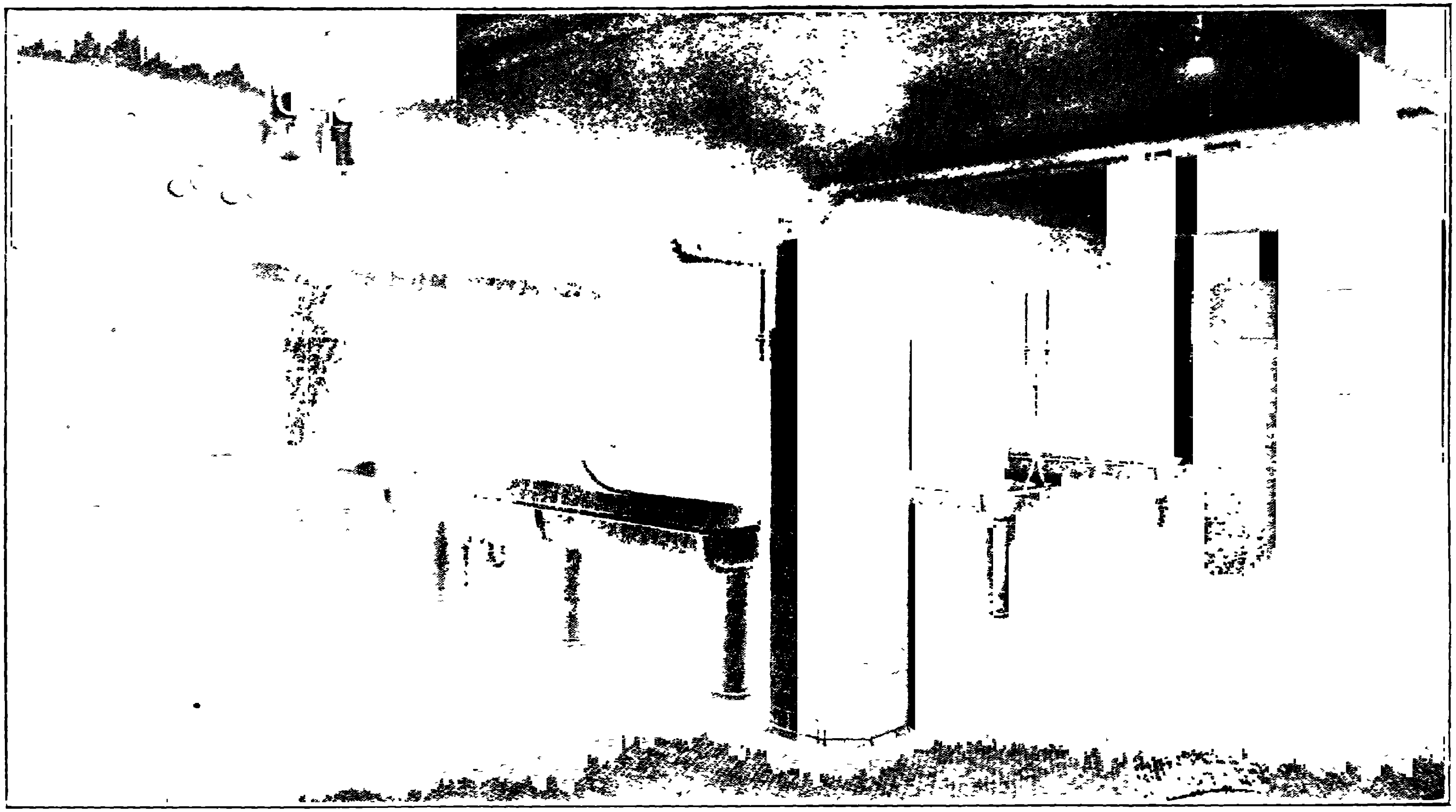
For each additional 25 employees there should be at least one additional wash-basin; this is the irreducible minimum, and at least one unit for every six men is recommended. The state requirements are usually based on the total number of employees in a plant, making no distinction between those which have different shifts. Should all employees leave at the same time and all desire to use washing facilities, one for every eight persons would hardly be enough. Hence state requirements are adequate where workers leave at different times.

In special industries or departments where workers are



Courtesy J L Mott Iron Works

Figure 24. View of wash-room of Norwalk Iron Works



Courtesy Indianapolis Drop Forging Company

Figure 25 Interior view of wash-room, showing vitreous marble stands, tiled floor, wainscoting, and columns

exposed to poisonous acids or alkalis or where the work is specially dirty the Massachusetts State laws require one wash-basin for each five employees. Adequate washing facilities are specially needed for workers who handle lead salts. In establishments where food products are manufactured, or unwrapped food products are packed or sold, the wash-basins should be supplied with soap and towels and the washing facilities may be placed in the workroom. Employees in such plants are notified to clean their hands before beginning work and after using toilets. Where separate wash-rooms for the two sexes are provided, the dividing walls should be of solid construction carried to the ceiling. Clear glass partitions may be used where only males are employed, but in rooms used by females translucent glass should be used.

Porcelain enamel basins, troughs, or sinks and wash-fountains are now in general use. State laws require that every wash-basin should be made of vitrified glazed earthenware, enameled iron, or other glazed material impervious to water. As in the case of other types of earthenware, what are known in the trade as "seconds" may be used with considerable economy. These are sold cheap because of some discoloration or flaw which does not interfere with their usefulness in the factory. The wash-basin centers are placed 24 inches apart.

Porcelain wash-basins are expensive and, in the last decade, cast-iron troughs have come into general use. These are enamel-lined and painted outside and are provided to the extent of one faucet or 24 inches of trough for each three to six men finishing work at one time. In some cases the trough is provided with a spray faucet high enough for the user to get head and shoulders under and they "are so much to be preferred (by the employer) to individual wash-bowls that the latter are not considered here." The B. F. Goodrich Company uses an 8-foot unit of white-enamel steel ware equipped with five goosenecks provided with sprayheads 2 inches in diameter and located 20 inches from the bottom of the trough. Troughs are preferred to washbasins because they are cheaper both as to first cost and upkeep. If basins are used, some one has to clean them. The troughs have no stoppers and hence the workers use only running water.

More water is used but the difference is slight. Foot-operated valves under the troughs tend to reduce the waste. Bowls are usually required by law merely because the law changes more slowly than the fashion in washing methods. In some places tin basins are used in the troughs and the compromise is all right if each man keeps his own basin, which, as a rule, he does not. If there are some new and some old wash-bowls competition is keen and sometimes amounts to a riot.

The latest variation of the trough is the "circular fountain" which consists of a circular bowl with a spray in the center. One water inlet controls the flow of water and hence leads to waste. One fountain can provide for 6 or 10 persons at one time and is said to be economical of space. "Bowls for 24 persons require a minimum of 91 square feet of floor space, while the wash-fountains accommodate the same number in 64 feet."

In 58% of a number of plants it was found that employers allow time for washing during working hours. Unless adequate facilities are provided, the time cannot be reduced. One employer found it economical to have a gong sounded when workers were allowed to wash up. It has been noted that between 80% and 85% of workers leaving at one time use the washing facilities and the percentage increases where men live far from the plant.

The method of cleaning and drying hands is one of the minor problems to be considered. E. G. Grace, president of the Bethlehem Steel Corporation, in a recent bulletin called attention to some of the expenditures by his company; the cost of soap, for instance, was $8,161 and that of paper towels $14,780. In some cases a towel supply is necessary; in all it is desirable. Of a number of companies, from which enquiries were made, 75% supplied an individual towel service; of these, 34% had roller towels and 41% used paper towels. The "common towel," one used by more than one individual, is dangerous, though not so much where there is proper medical service. Epidemics have been traced to the use of the common towel, which is forbidden in some states.

In all factories where lead, arsenic, or other poisonous substances are present, the washing facilities include the use of individual towels, which may be of paper or "linen."

In plants where individual linen towels are supplied, they are issued on requisition, the person making the request turning in a used towel, or there is a regular distribution twice a week and collection of the soiled towels. In one plant towels are furnished in the administration building only. A new supply of hand towels is furnished daily in each lavatory or dressing room and the soiled towels are cleaned in the company's laundry.

The employer has several choices in hand drying; either the individual or roller linen towel, the paper towel, or hot air. The standard size of the linen towel is 36 by 17 inches, or at least 5 square feet should be supplied for each worker and renewed or washed daily; the area, however, may be less without hardship. If roller towels are supplied, at least 15 square feet should be provided for every 3 workers and should be renewed or washed daily. One towel may be provided for every 9 workers and renewed after each meal or at close of the day's work. Theft of individual towels or improper usage is not unknown and, therefore, it is very desirable to have the company name woven in or stamped on each towel. This plan reduces theft or improper use substantially. Some employers supply two towels per employee per week. To supply 1,000 workers with this number about 3,500 towels are needed and about 100 per employee each year will be laundered.

Employers desiring economy should test the relative cost between linen and paper towels. Paper towel companies indicate that three paper towels will be used per day, but this does not occur in practice. The Metropolitan Life Insurance Company investigated the cost of its towel supply and found the following:

TABLE 90

COST OF TOWEL SUPPLY OF THE METROPOLITAN LIFE INSURANCE COMPANY

Number of towels supplied per employee	3
Cost of towels per dozen	$2.40
Cost of towels per employee	.60
Withdrawal of towels and cost	20-25%
Laundry, 104 towels per year per employee	$0.466
Interest charges at 6% per employee	.036
Replacement cost per year	.120
Excess; extra towels, and so forth	.0442
Cost per employee per year	.6662
Cost per employee per day	.00213

Loss and withdrawal of towels showed that 20% of the stock had to be replaced in the year. Using the above figures as a basis the cost of paper towels was found to be several times as high as linen towels.

A few companies have a hot air supply for drying hands. The air supply is opened by the foot when needed. The same device is used in department stores.

Soap is another of the minor problems. Its use in poisonous occupations and in the manufacture of foodstuffs is obligatory, and in other occupations advisable. Cake soap, if supplied, should be distributed once a week or more, depending on average experience, and should be kept in each locker when not in use. The tendency is, however, to leave the soap at the wash-basins and thus there is indiscriminate use and generally waste. Another source of waste is pilferage, and to avoid this the name of the company should be stamped on the soap or it should be of a distinct shape or color; as a petty economy the discards may be melted up for cleaning.

In recent years liquid soap has become a fashion which has a certain amount of convenience to recommend it. The containers are always in place and cannot be removed, but they sometimes get out of order; however, they are repaired free of charge by the companies supplying them. Unlike cake soap the liquid is always available as long as the containers are kept filled, and this duty, like that of providing solid soap, has to be attended to occasionally, but the liquid "stays put" and the solid does not.

The soap containers "are loaned to purchasers" and the liquid soap is sold for somewhat over $2 per gallon. Whether it would pay large plants to use one kind of a soap instead of another is a matter for investigation. Acceptance of new for old devices without examination of their respective economic claims is hardly a wise proceeding. And the wishes of those using these devices should be consulted. The parsimony of liquid soap is nowhere so futile as in the machine shop.

SHOWERS

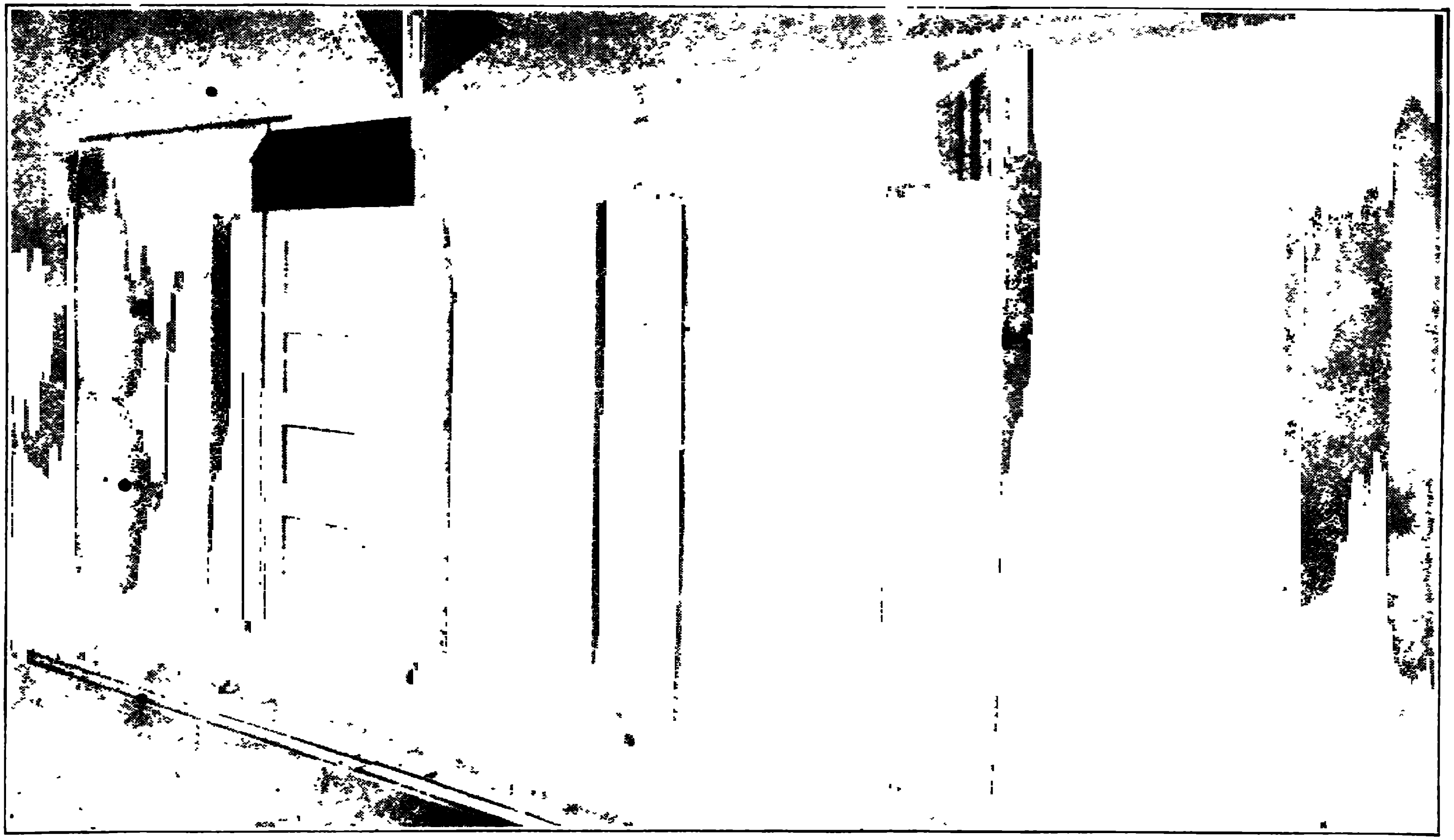
A not too limited experience gives the impression that workers like to clean themselves before going home and the impression is confirmed by having watched generally reputed dirty foreign-born workers at the wash-up time stripped to the waist trying to clean themselves with cold water from a bucket. Contradictory opinions exist; various stories are told about the failure of men to avail of the facilities provided for them, and this is said to be true about showers particularly.

There are some occupations in which the workers customarily get bathed in sweat and where, moreover, they work in noxious dusts. In such cases, if the shower-bath is convenient, not too crowded, and properly equipped, it will be gladly used. "Of all types of baths—cleansing, recreational, refreshing, healing—the cleansing bath is the foremost in importance not only for health of the individual but for the attainment of a higher degree of sanitation in the community." The prevalence of "colds" is one of the most serious sources of lost time in industry and rheumatism is not an inconsiderable factor. These two maladies often arise from the fact that workers who get overheated sweat freely and go home in drafty cars without changing their clothes. The use of showers and change into street clothes avoids these troubles to some degree.

Over 52% out of 431 establishments, investigated in 1917 by the United States Department of Labor, provided shower-baths for the workers. In plants where workers are exposed to dust, dirt, the handling of poisonous materials, excessive physical exertion as in the stoking of furnaces, in heat or humidity, shower-baths should be provided. Ordinarily one shower-bath is quite sufficient per hundred employees, but a much larger number is needed sometimes. Four per cent may be supplied in dirty occupations, and 10% or more in dangerous occupations such as lead.

"Wash-rooms, hereafter installed, where 20 or more men are employed, shall be provided with at least one shower-bath with an ample supply of hot and cold water," according to the Pennsylvania State requirements. In the United States Steel Corporation, "the number of showers should be not less than 4% of the maximum employed at one time." It is significant to note that a recent bill has been passed in England making the installation of pithead baths compulsory within three years, although some will have it that the miners don't want them and won't use them.

Three types of showers are in more or less general industrial use. The individual shower, sometimes open, sometimes screened, and sometimes provided with a dressing cubicle; the shower over a wash-tub; and the emergency shower. The latter two are infrequently used. The wash-tub shower is a compromise between a real bath and a real shower with the virtues of neither. The emergency shower is provided, sometimes in the open, where men work with acids or other poisons. The du Pont Company, for instance, uses an emergency shower elevated 6½ feet above



Courtesy Illinois Steel Company

Figure 26: Shower-bath installation with wooden slat floors and hoods to carry off vapors

standing level. The first arm of the shower is 18 inches long and made of a 1½-inch pipe; there are three projecting arms made of 1¼-inch pipe 10 inches long; ³⁄₁₆ holes are drilled in the under side of the pipes at 1¼-inch centers, and there is a quick-opening valve 3 feet from the ground. A worker who has been splashed with acid can use the shower without delay.

The shower in general use consists of an area 3 by 7 feet, allowing a space of 3 by 3 feet for a shower compartment and a space of 3 by 4 feet for a dressing booth, the entrance to both being staggered so as to dispense with the need for doors or curtains.

The floors and walls are of hard, non-absorbent, undefaceable material. The floors slope for drainage and are non-slipping, either of tile or concrete with coved bases and rounded corners. Slats of wood over concrete provide a safe floor which drains easily. There should be a hood to carry off steam and provide ventilation, unless special provision is made.

The object of providing a dressing booth, with seat and clothes hangers, is to induce men to use the showers by making it private and comfortable for them to dress and undress. A curtain should be provided if there is danger of splashing, but this is not necessary if the entrance to the shower compartment is narrow. In some plants there is a series of shower heads three feet apart without intervening partitions. It is better, however, to provide partitions since horseplay is prevented and privacy secured. The partitions may be of slate or pressed steel painted, the latter being less durable.

The temperature of the shower compartments should be about 65 to 70 degrees, Fahrenheit, and the lighting should be put where men can see what they are doing. Hot water should be provided at a temperature of from 90 to 100 degrees, regulated by valves attached to heater. The showers should have a hot and cold mixing faucet to regulate the temperature of the water. The valves should be at the entrance to the shower so that they can be operated without wetting the operator. About a gallon and a half of water may be supplied per minute, or about nine gallons per bath. The average daily consumption may amount to as much as 30 or 40 gallons per man. It is sometimes desirable to meter the water in order to control waste.

The equipment of a shower compartment consists of a shower head about 7 feet high, set at an angle of 45 degrees with a spray head 4 inches in diameter made of cast bronze, nickel-plated, and with small perforations. There should be a soap tray with perforations firmly attached to the partition.

It is not easy to foretell to what extent showers will be used. In the Crompton and Knowles Company 13,000 baths were taken in two months of summer by the foundry employees. The rate of usage is decided by the season, the nature of the work, the location and convenience of the facilities, and personal habits and preferences. If showers are provided for women they should have only a side and not an overhead spray. An English firm, the Ocean Colliery Company, employing 2,200 men at the mines, found that between 60% and 70% used the showers. In the same company each man takes about 7 minutes for a bath and there are 70 sprays, which serve 420 men per hour. Where dressing booths are provided, about 15 minutes is taken and this is the principal argument against the use of dressing booths in shower compartments. The alternative is to place the dressing room as close to the battery of showers as possible, taking care to provide for sufficient ventilation to prevent the steam escaping into the dressing room.

SWIMMING POOLS

The purpose of providing swimming pools for industrial employees is recreational rather than cleansing. The shower is a necessary adjunct to the swimming pool; the swimming pool is an accessory of the factory club room.

Bulletin Number 250 ascertained in 1917 that, "Out of 137 establishments having club rooms, 41 have provided baths or swimming pools. In 27 of these the pool is inside the club house, in 13 establishments outdoor swimming pools are found and one establishment did not report the location of its pool." Usually the pool is located in the basement, occasionally on the first floor, and sometimes in a separate building. In warm climates the swimming pool is outdoors.

The pool is constructed of concrete, tile, or steel. The average size is 20 by 60 feet, with a depth of 3 to 7 feet and a capacity of nearly 1,000 cubic feet. Usually the bottom is flat and sloping though the spoon-shaped bottom is best for drainage, and it allows maximum depth for diving. Figure 27 represents a plan and elevation of a swimming pool of the so-called "spoon shaped" variety showing connections with a purification system. The contents of the pool are refiltered once during each period of daily use at the rate of three gallons per minute per square foot of filter service.[1]

Pool water should be maintained in a transparent state. Unless the inflowing water is pure, clear, colorless, and fresh, steps will have to be taken to filter, refilter, and disinfect. It is said that pressure water filtration can be installed at little expense. Filtration alone cannot be relied on to maintain the purity of pool water and it should be disinfected by hypochlorite of lime, ozone, chlorine gas, or ultra violet rays.

The state of California suggests a minimum of 800 gallons for each bather in pools of the "fill and draw" type or where there is replacement by new or purified water.

Birmingham, Alabama, and the Tennessee Coal & Iron Company have erected, at a cost of $45,000, two pools 50 by 100 feet each, by 3½ to 9 feet deep in the open, surrounded by buildings, and each pool contains a quarter of

---

[1] Crane, Arthur M. "Swimming Pool Standards," *The Nation's Health,* February, 1924, p. 100.

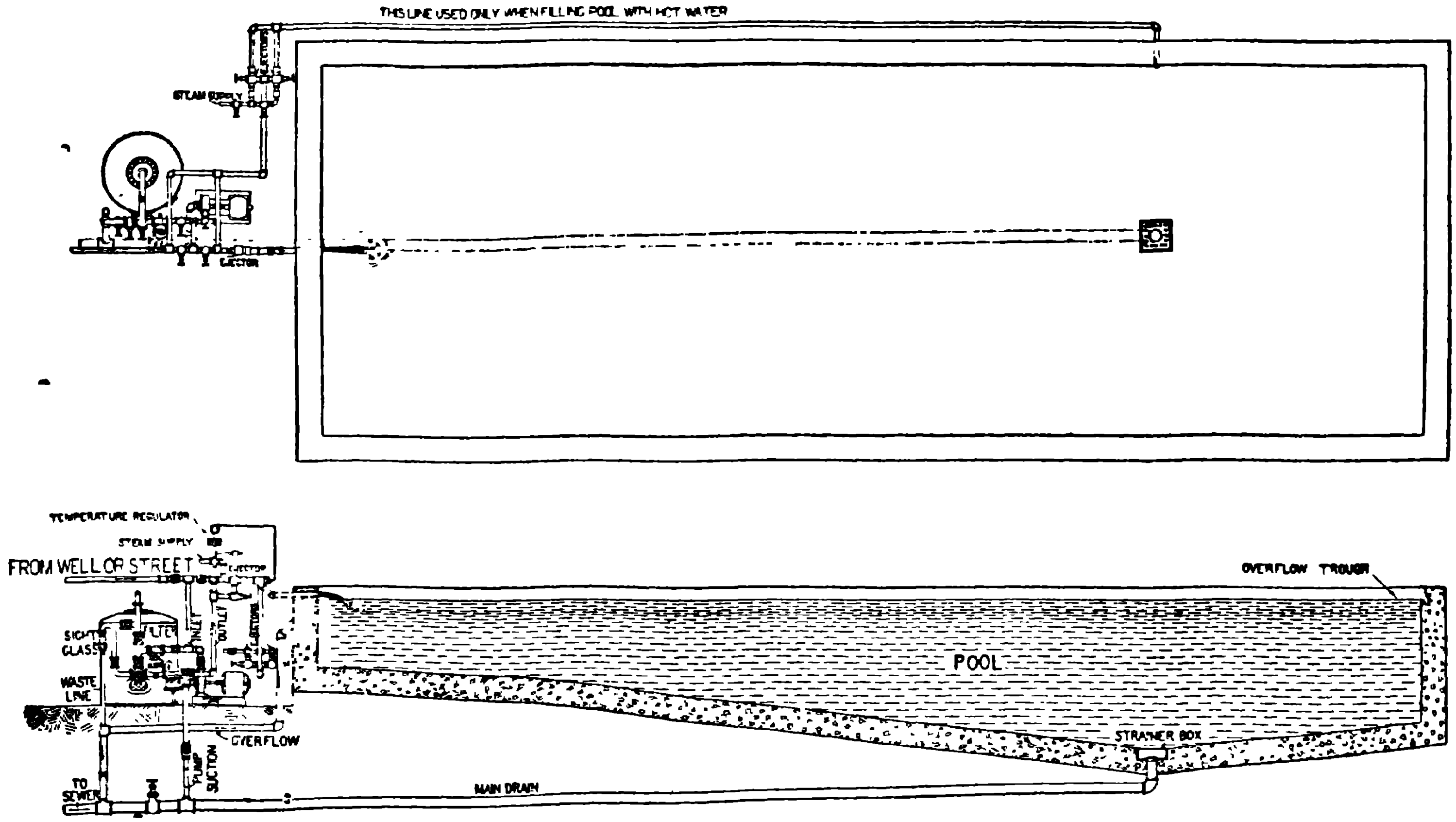


Figure 27: Plan of swimming pool installation

a million gallons of water. The water is pumped through pressure filters and ultra violet ray sterilizers. The attendance at these pools varies from 300 to 2,000 persons a day. The Burroughs Adding Machine Company has a swimming pool which occupies a room adjoining the gymnasium and is about 15 by 32 feet. Several showers are connected with the pool.

Among the comparatively few establishments reporting as to the numbers using the swimming pools, one, having 2,370 employees, said its indoor pool was used by about 2,000 in every month; another, with 2,815 employees, reported that the pool was used by 3,713 in one season; still another, having only 748 employees, said that 1,580 used the pool in one month. One concern said that, with 1,708 employees, its outdoor pool was used by 200 persons per day during hot weather, and another establishment, with 6,681 employees, that had an outdoor pool convenient to the homes of many of its employees, reported that 102,000 had made use of it during the season. These facts, for convenience of reference, are presented as follows:

TABLE 91

USAGE OF INDOOR AND OUTDOOR SWIMMING POOLS

Number of Employees	NUMBER USING POOL Month	Season	Type of Pool
2,370	2,000	.....	Indoor
2,815	.....	3,713	Indoor
748	1,580	.....	Indoor
1,708	5,000	.....	Outdoor
6,681	.....	102,000	Outdoor

If a swimming pool is to be successfully conducted there should be strict supervision of the bathers, periodical physical examination, and inspection before entering the pool. All bathers should have a shower-bath before entering the pool and soap should be liberally used. Unless this precaution is taken it will be impossible to keep the pool reasonably clean. Bathing suits should be sterilized by the establishment. In plants with efficient medical departments the possibility of contagion through the use of swimming pools is reduced. Some person proficient in swimming and life saving should always be in charge while the pool is in use. This may be a paid attendant or some members of the committee who are responsible for the management. Such regulations as the above are recommended by the American Association for Promoting Hygiene and Public Baths.

XXIV

LOCKERS AND LOCKER-ROOM

The locker-room; location and equipment. Types of lockers: wooden or metal. Size, color, and material. Arrangement of lockers. Equipment: shelves, hooks, locks, and keys. Ventilation and heating of room. Inspection. Ceiling hooks. Methods of drying clothes.

A DRESSING- or locker-room contains the lockers, clothes racks or hooks which are used by employees in changing their clothes before and after work. It is sometimes spoken of as a cloak-room when used by females and a change house in the mining industry. All serve the same purpose and are usually near, if not actually a part of, the wash-room. The desirability of having them close together, especially when showers form part of the equipment, is apparent. Dressing-rooms are useful in every plant, but they are a necessity in dusty, poisonous, or mining work and where men live some distance from the plant. Sanitary rules and regulations demand that, "a clean place shall be provided for employees in all factories in which to change clothes." When there are both sexes the dressing-rooms should be separated by solid partitions.

Three stages of development are noticeable in lockers. In some plants the workers still continue to hang their street clothing on nails in the wall near the work and they are thus subject to dust and theft. In the second stage the worker builds himself a wooden locker—a fire danger—on company time, and places it in some disused corner. The modern idea is to provide a separate locker-room near the washing facilities and equip it with steel lockers, one for each employee. In some places the locker-room is part of the operating floor but separated from it by a glass partition with the lockers arranged in rows to discourage loitering. It was found in a recent investigation that 85.8% of several hundred plants had supplied lockers for the use of their employees. The dressing-room is much the same in design as the wash-room, except that windows should be placed high in the wall to ensure privacy and to avoid drafts, but they should nevertheless be ample in size to ensure good ventilation and there should be some ready means of opening them to the fullest extent if necessary. According to the New York State requirements, for instance, "Every dressing-room . . . enclosed by walls which extend to the ceiling, unless provided by windows which have an area not less than one-tenth of the floor area opening directly to outside air, shall have exhaust ventilation not less than six air changes per hour. The temperature should be maintained at not less than 58 degrees Fahrenheit, while the lighting should be so that the room in all parts is easily visible."

Lockers constitute the main, if not the only, essential equipment for dressing-rooms. Provision of one for each employee hardly necessitates any argument. This is the ambition if not the accomplishment of every well-managed plant. It is only occasionally that clothing is still hung on the wall in the work place. Primitive as such an arrangement is it is better than an ill-ventilated, verminous, cold locker-room.

Various methods of assigning lockers to new employees are used. The simplest is that whereby the time-keeper has a sheet of all check numbers with the corresponding number of the lockers. When the check number is removed the locker is available for assignment to a new man. Sometimes assignment is in charge of the foreman or the person in charge of the dressing-room.

Lockers should be placed as near as possible to the work so as to facilitate men's punctuality and prevent them from having an excuse for leaving work before it is time to finish. If possible, since lockers are a factor in starting and finishing work, they should be placed between the gate and the work. In large establishments locker-rooms are desirable in each department or building. In foundries, furnace rooms, or large one-story buildings locker-rooms may be placed under the roof, perhaps in a side bay where the light and ventilation are good. Sometimes the locker-room can be placed on the mezzanine of a high ceiling room if the arrangement does not interfere with the light.

In preparing to equip a plant with lockers, the following points need consideration:

Width
Depth
Height
Color
Hooks
Shelves
Alternative color
Material, front and back
Material, thickness
Floor of locker
Height from floor
Number in group
Erected or knocked down
Shape of top
Kind of key
Keys
Master key
Bolts and nuts

Lockers should be ordered in as large a group as possible since this reduces the cost. It is advisable to order stock sizes since odd sizes increase the cost materially. When the floor space is limited, the locker may be 12 by 12 by 70 inches or it may be half the height and the lockers tiered. But short-sized lockers do not allow clothes to hang. An average and a satisfactory size is 12 by 15 by 60 inches, but in cases where men have wet clothing due to the nature of their work, a larger size is desirable, and 15 by 15 inches may be used to advantage. The size of a locker depends somewhat on the nature of the work. In some offices there are miniature lockers for hat, comb, and brush. Unless a good system of ventilation is provided, small lockers will not prove adequate for drying damp working or street clothes. The real function of lockers is not only to keep clothing safely, but it is also a means of keeping them free from factory dust and drying them, if wet. A real necessity exists in heavy work for drying wet clothing overnight. When a worker starts work each morning with clothing still damp from the efforts of the previous day he accumulates a dissatisfied outlook which does not help his work.

Diversity of opinion exists as to the relative merits of flat and sloping locker tops. Locker tops are used as a depository for articles that should be in the locker and if the latter is big enough there is no excuse for not having everything inside. Sloping lockers effectively prevent the storing of anything on top without the effort of enforcing a rule. Essential to cleaning, ventilation, and convenience is the placing of lockers on legs at least 6 inches high, and preferably 12. When the legs are short, floor cleaning is difficult and the use of a water jet is impossible.

Lockers which are not properly painted soon become rusted and useless. They are sometimes exposed to the damp and steam of an ill-designed shower system and sometimes the clothing is wet and drains on the floor of the locker. Either possibility indicates the need for a well-painted locker. Olive green is the prevailing color; it is gloomy, but white enamel, which looks so much more attractive and brighter, costs a considerable amount more. It is almost worth the difference, however, because the condition from a hygienic view-point can be determined so much more easily. It is often noticed that while lockers are painted, the bolts and nuts which hold them together are not; they loosen or rust and it is, therefore, desirable in procuring lockers to insist that all parts, including bolts and nuts, should be painted. This is specially necessary in plants exposed to acid gases.

No one favors wooden lockers; they are a distinct fire risk and very insanitary. Expanded metal, or sheet metal with perforations, is almost universally used for doors, while the back, side, top, and floor are made of sheet steel. If the plant is dusty, sheet steel is to be preferred; if the plant is wet, expanded metal allows the air to circulate and helps the clothing to dry. In all cases there should be some perforations in the metal to provide ventilation.

Lockers should be equipped with numbers which, if removable, facilitate adjustment. It is desirable to have one shelf at least a foot from the top; then the remainder of the locker allows clothing to hang at length. Each side, except the door, should have double hooks and there should be one hanging from the center of the shelf to hold a heavy overcoat.

Locks and keys are an inevitable but necessary nuisance. There are several varieties to choose from, but hardly any with such distinct merit as to be singled out for unqualified praise. The flat-keyed lock is generally useful if not too lightly built; the keys are also too light and bend under the powerful muscles of the worker who habitually applies his strength in the shop. The combination lock or the keyless lock are somewhat of a nuisance and not to be considered for illiterates. The padlock is generally the most practical but it can be twisted off. Some people favor the latch which can be pulled out and up to open the locker. It may be said that all lockers necessitating the use of keys cause trouble because men forget their keys and in the anxiety to get to work on time break the lock. Too little attention is given to the matter of locks. The whole basis of trouble is really that, in an effort to produce a locker at a competitive price, all equipment is attenuated to the last degree; the sheeting is too thin, the legs are too frail, the locks are far too light, and the handles break.

When keys are issued they should be charged for beforehand, and the money returned when an employee is leaving. This is a better plan than trying to collect when a worker is leaving, not because it secures the employer against loss, but it makes workers more careful with their keys; the usual charge is 25 cents. Locking is compulsory since one of the main objects of providing lockers is to prevent pilferage. If the locking arrangement permits of automatic closing it is comparatively easy to provide against theft.

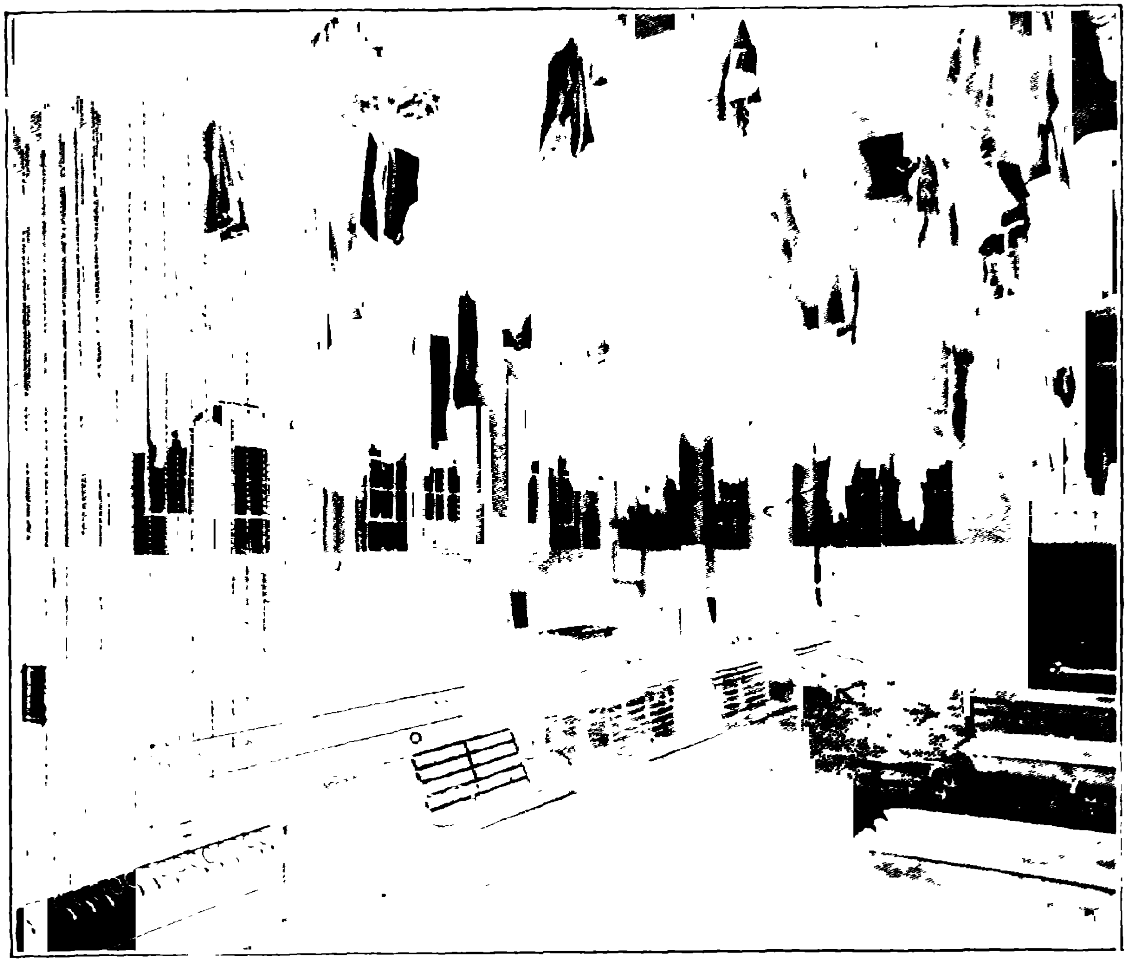
Ventilation of lockers and maintenance of sufficient heat to dry out wet clothing is an important phase. When the lockers are raised sufficiently high from the floor there is room enough for hot pipes underneath, in fact the piping might easily form a securer locker base than what they usually stand on, and cleaning under the base is easier. It is not easy to secure the proper ventilation of lockers and sometimes an exhaust which sucks air from each pair of lockers is used.

Having provided the right kind of locker and ventilation it is necessary to see that they are kept in good condition. Periodic inspection is found to be necessary. Workers have a way of accumulating odds and ends and the lockers get into disrepair. Lockers need periodical cleaning. All clothing should be removed and the lockers thoroughly swabbed out at least once a month or before a new worker takes one over. If this is not done lockers become verminous.

In plants having no lunch rooms food is sometimes kept in lockers, but food attracts mice and insects; besides it is difficult to heat the room without spoiling the food. When a lunch room is provided, workers may be forbidden to keep food in their lockers.

An alternative to the locker system is the ceiling hook. Ceiling hooks are better and cheaper than small, ill-ventilated or damp lockers. They provide one essential in the care of working clothes, drying, and comparative safety. Clothing, hung on a hook, is raised to the ceiling by a chain and pulley and is locked in position by a fastening below. A wire tray or basket is provided for shoes and small articles, such as brush and comb. If the hooks are not too close together and if hot pipes are provided to dry out the clothing, the system is satisfactory and floor space is economized. It is, of course, possible to take the clothing by using a ladder or long stick. Ceiling hooks have their greatest vogue in steel mills and mining, but the tendency is, even here, towards lockers. The Youngstown Wire and Iron Company has locking racks formed of vertical tubes fastened by means of a strap bar, resting on horizontal angle bars and supported by tubular end posts and columns of the building. The janitor carries a master-key in case an employee loses his key.

Another means of drying wet clothes, as in the case of



Iron Age, July 14, 1921

Figure 28. View showing use of ceiling hooks for workmen's clothing

street-car conductors, is by means of drying compartments which are electrically heated boxes with hooks. Sometimes a tumbler barrel, through which warm air circulates, is used for the same purpose.

Another alternative to lockers is the use of numbered racks. They are favored for economy and ventilation but are objectionable on account of pilfering. They prove satisfactory for drying clothing by means of the free circulation of heated air.

XXV

LAUNDRY AND CLEANING

Growing use of plant laundries. Their location, equipment, and installation Scope. Advantages. Plant cleaning and hygiene. State laws and cleaning. Organization of cleaning department. Supervision. Hand and mechanical cleaning. Cost of plant cleaning.

PLANT laundries are growing in popularity, and uses are being found for them which, a few years ago, would have hardly been considered either as advisable or necessary. In plants which have lunch rooms, medical departments, or where towels are supplied to workers, a laundry is found to be both economical and useful. Further, in some of the heavy, hot, dirty, and poisonous tasks, the laundering of workers' overalls is now provided.

In the comparatively few instances where plants have laundries they are placed in the basement of the administration building, adjacent to lunch room, hospital, or working place. A laundry is generally considered as a personnel rather than as an operating activity, mainly because the interests of the employee are served.

Many uses can be found for the plant laundry once it is installed. First, there are towels for the office, hospital, and plant, perhaps at the rate of two a week for each employee; then, there is linen for lunch rooms and hospital, including napkins, towels, or uniforms for the hospital staff, nurses, janitors, office and, perhaps, overalls for mechanics and female workers. In special trades, such as lead working, painting, and furnace work, it may be advisable, and actually has been found so, to have underclothing washed and returned to the worker dry in the morning. Where workers habitually end the day with sweat-saturated clothing, such a plan is desirable.

The equipment of a plant laundry is confined to a wash-tumbler, an extractor, drier and ironer, varying in size with the amount of work to be done. In the Greenfield Tap and Die Company one man launders for 2,000 workers. Generally the capacity of the laundry should be based on about three pieces per man per day, depending, of course, on the scope and nature of the laundering to be done, as it may include aprons, caps, and white ducks.

In installing laundry machinery all extractors, belts, pulleys, shafts, and ironers should be guarded according to modern ideas of safety. The laundry should be provided with exhaust ventilation for heat and humidity, good floor drainage and dry standing room, toilet facilities in the case of large units, heat deflectors or ducts for ironers, seats for workers, disinfection of soiled linen, and room to separate clean from dirty clothing. The laundry should be laid out according to sequence of operation as is customarily done in plant procedure.

In one plant a large truck passes through the departments every week to pick up soiled aprons. Each worker is given a clean apron in exchange for a dirty one and a nickel.

The advantages of a plant laundry are that, owing to the promptness with which goods are returned into service, a smaller stock is needed than where soiled clothes have to be sent out. Plant laundering of overalls relieves the workers' home laundering, preserves linen by avoiding the use of chemicals, enables the workers to keep their clothing clean, reduces the chance of infection, increases morale, and is more economical than when done by an outside firm. Among the companies which have installed laundries are an automobile manufacturer, a soap company, three paint plants, one printing establishment, and three metal companies. In some instances facilities have been increased since the first installation. This is indicative of satisfaction, but the value of plant laundries is sufficiently obvious to merit attention in progressive concerns.

PLANT CLEANING

Some establishments have a highly organized method of keeping their plant clean, because the nature of the product demands it. Not infrequently the maintenance of hygienic standards is achieved at the same time. However, plant cleaning is usually contemplated from the point of view of the product and not that of the worker, and the result is that success is only partial; places look clean, but they either fall below the demands of health, or the methods used to clean are unsanitary themselves.

State laws in the largely industrial centers demand that "every room in a factory and the floors, walls and ceiling, windows and every other part thereof, and all fixtures shall be kept in a clean and sanitary condition, "and, further," that dry cleaning is not permitted in any place where food or drink is prepared." As regards the plant, "every part of a building . . . and the yards, courts, passages, areas or alleys connected therewith or belonging to same shall be kept free from any accumulation of dirt, filth, rubbish, or garbage."

Apart from the urge of state laws to maintain the plant in a sanitary condition there is sufficient justification in the fact that sanitation involves the prevention or disposal of wastes, lessens the fire risk, increases safety, and tends to improve morale and health. "The average person will do more and better work in a clean factory."

The scope of factory cleaning is plant-wide and cannot be accomplished unless the place is kept in repair, as, for instance, in the case of floors, which, if they are defective, cannot be properly cleaned. Cleaning includes, also, the walls and windows, the machines, and all the interiors, as well as the passageways, yards, and driveways outside. It involves the removal of plant wastes, garbage, rubbish, and filth, the placing and keeping things in order and, in fact, the doing of anything that will help production, as well as maintain the health of the workers.

The organization of a cleaning department, instead of leaving each section to do its own cleaning, is generally necessitated by the fact that production men usually look on cleaning as a side-issue and only to be considered at odd moments, if at all. The prevailing method is to make foremen responsible for the cleaning of their own departments, and this means that there are as many systems and methods as there are foremen. When one department dovetails into another it is impossible to get satisfactory results by the piecemeal method. In an investigation by a large motor corporation 44% of the 22 divisions had their plant cleaning supervised by foremen, 36% had separate cleaning departments, and 20% had a sanitary department which was responsible for cleaning. Usually the department under which the cleaning should be carried on is dependent on the view taken as to its aim. It is largely regarded as a maintenance problem, not infrequently as a safety measure, sometimes as a purely cleaning job and occasionally as part of the welfare work, but hardly ever as a hygienic measure.

In some plants the onus for keeping a plant clean is thrown on the individual and a special time, usually Saturday, is set apart for the purpose, and there is a general clean-up week twice a year. Promotion of this system is secured by publicity through bulletins, talks, and the plant periodical, but it is apt to be incomplete and wasteful of time in making cleaners out of producers. Plant cleaning, to be satisfactory, is the job of an expert needing special apparatus in many cases, so that it may be done thoroughly and well.

Hand cleaning still survives in the small plant and the traditional supernumerary, with the mop and broom who scatters instead of takes up the dust, survives. In the larger plants this is altogether replaced. There are rotary brushes for scrubbing floors at a saving of 50% over the hand method; there are vacuum sweepers for local and general use, the first being used during working hours round the machines and the latter after hours for the whole place.

Collection cans, properly labeled, are placed at convenient intervals. They are made of sheet iron to avoid the danger of fire and, if used for liquid, are water tight. Empty carbide or alkali cans are sometimes used for this purpose and are mounted on wheels to save effort in removal. In some plants chutes lead to the basement from each floor and the refuse is collected and classified for disposal. Finally there are incinerators to burn the rubbish and generate steam.

The regular cleaning staff is kept as small as possible and is aided by watchmen, janitors, and elevator attendants when not engaged at their regular work; this includes, also, rest-room attendants, toilet caretakers, sweepers, and scrap handlers. In the Pierce-Arrow Motor Company, there are 133 persons in the cleaning force to 7,000 employees.

In the large automobile organization before mentioned the space to be cleaned amounts to 16,112,160 square feet and the cleaning cost $171,979 per month with an average of 73,000 employees. The cost of cleaning operations per employee per month amounted to $2.34, while the cost per square foot of floor space per month was .017 cents.

XXVI

DRINKING WATER AND BUBBLERS

Importance of water supply. Water testing and water purification. Methods of supplying drinking water. The pail and the bubbler. Apportionment of bubblers. Types: vertical or slanting. Refrigeration. Temperature.

FORTUNATE is the plant that draws its water supply from an unquestioned and pure source. Plants are variously situated in this respect. Many have been erected with full consideration given to the adequacy of the industrial water supply, while but little attention was given to the supply of water for human consumption. Rain, river, or well water is used where there is no city supply available, and herein lies the possibility of contamination.

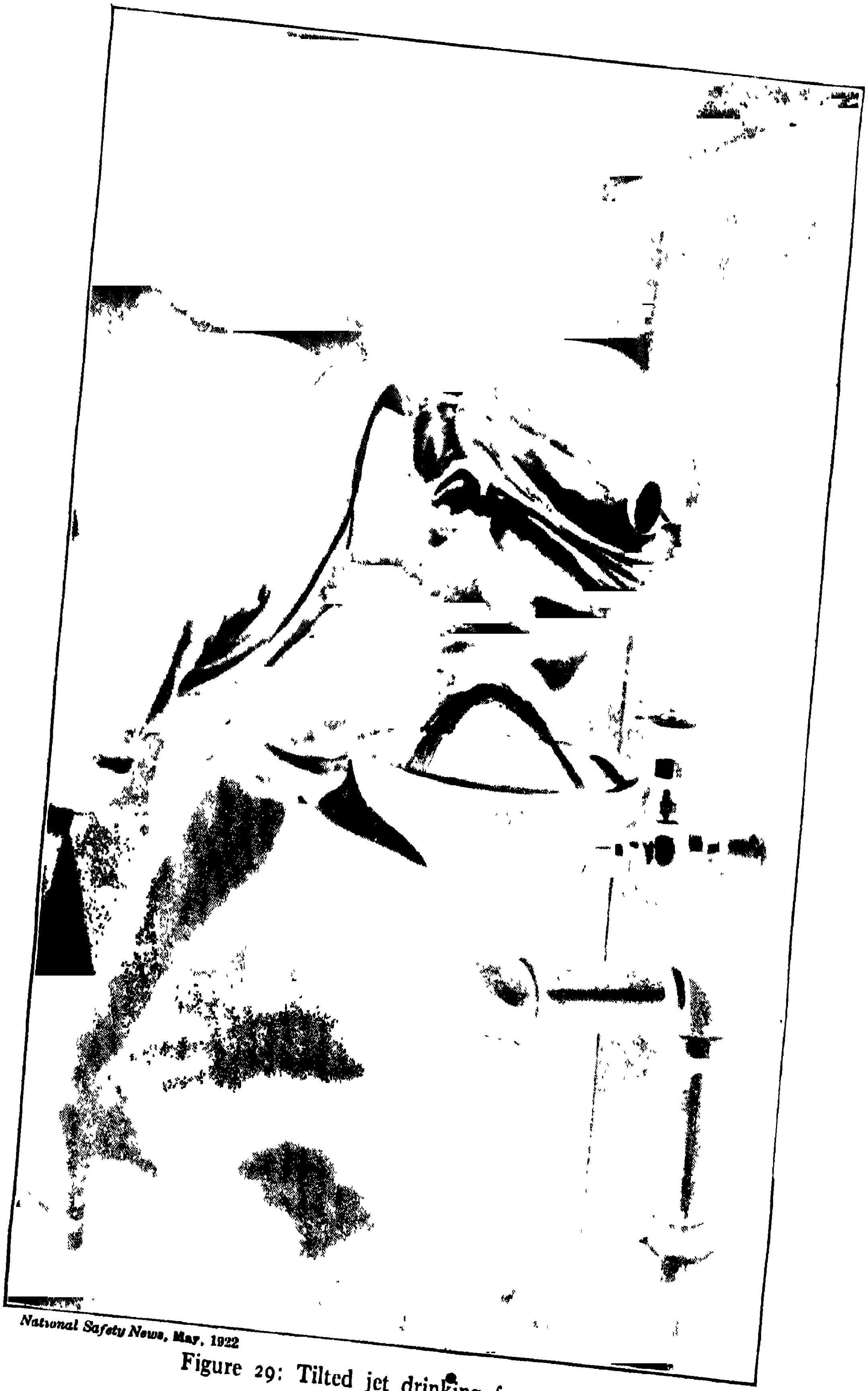
It is generally safe to assume that a city water supply is pure, although instances of contamination have occurred, with disastrous results. The custom, in well-managed plants, is to leave nothing to chance and, therefore, periodic analyses are made even of the city supply. When water is not of known purity some system of purification is necessary. For this purpose 20 pounds of chlorinated lime are used per million gallons, and this seems to be one of the cheapest, most effective, and commonest methods used. Sometimes, however, the water is aerated by spraying it into the air from a large number of jets. Other methods are sedimentation, coagulation, and filtration. In this process the water is allowed to stand, sulphate of alumina or iron is added, and hence coagulation and precipitation result. The supernatant water is then filtered. Filtration is accomplished by gravity, allowing the water to flow from a high to a lower level, or by pressure which accelerates the process. All filters are apt to become clogged and need constant cleaning both as a protection to health and in order to prevent clogging.

The purpose of adding such materials as chlorine is to prevent the growth of bacteria in the water. Ozonation and ultra violet rays are also used to destroy bacteria. The latter method is used by such companies as the Goodyear Tire and Rubber Company. Occasionally pure water is obtained by distillation and subsequent aeration to make it palatable.

A plant may be provided with drinking water to the extent of a gallon or a gallon and a half per man per day, about 20 for washing, or for general purposes, outside manufacturing, about 80 gallons per man per day.

Although water is as necessary as food for health it is only in recent years that the subject has been receiving any organized attention in plants. The primitive, and still extant, method of supplying workers with water by means of pails and dippers has received, deservedly, legal condemnation. Open or covered pails or tanks of drinking water from which drinks may be secured either by dipping or pouring are obviously insanitary though they are to be found still in use. Workers seldom object to this type of hazard to health merely because they are not aware that the hazard exists. The presence of a film of dust on the surface is easily swept aside and does not appear to affect the palatability of the water. The use of a common cup, even with a pure supply of water, is also prohibited, and many plants now supply individual paper cups round or folded, which are used once and then discarded, a suitable container being supplied for the discards.

Discarding the water pail and supplying individual cups has not solved the problem, and great advances have been made in meeting it in a comprehensive way. The laws of the state of New York and other states demand that, "Every factory should provide at all times for the use of employees a sufficient supply of clean and pure drinking water . . . supplied through proper pipe con-



National Safety News, May, 1922

Figure 29: Tilted jet drinking fountain

nections with water mains." The aim of every progressive plant is to meet, if not exceed, these requirements.

The use of the "bubbler" has become quite general in the last few years in attempting to supply workingmen with pure and adequate water. It is an apparatus whereby a jet of water flows at an angle from a faucet on compression for the purpose of supplying a drink of water. The requirements demand pure water, in sufficient quantity, palatable, of the proper temperature, and accessible to the workers. The purity is determined by analysis if not from a source of known quality. To be palatable, water should be free from smell, color, and unpleasant taste, and ranging in temperature from 50 to 55 degrees Fahrenheit, and to be available, bubblers should be placed at frequent intervals throughout the plant.

The number of bubblers required varies from 1 to 50 men to 1 to 200 men, depending on the relative proximity of the men and on the distance they are from the source. One company has 120 bubblers for 10,000 men.

There are two types of bubblers. The vertical jet was the first to be used and it has practically been replaced by one with a jet which comes out at an angle so that persons cannot touch the orifice with their lips. Investigation seems to indicate that the vertical stream is more liable to contamination than the slanting stream. The support of the bubbler is sometimes cast-iron piping and generally vitrified cast iron or cement. The waste water flows to a sewer. The height of the flow is automatically arranged. Most bubblers are continuous flow. A self-closing cock put outside the bowl economizes water.

Refrigeration is necessary to cool the water supplied to and drawn from the system and to absorb heat that gets into the water in circulation. Galvanized wrought steel or brass pipes conveying water to bubblers may be insulated with cork covering. The water may be cooled by passing it through a coil of the supply pipe submerged in melting ice.

The portable cooler is made with an ice compartment. To determine the amount of coil required for a given service, divide the gallons used during an hour or two, which will give the square feet of coil surface, or half a square foot of coil surface for one gallon per hour. For 100 gallons an hour 50 square feet of coil will be necessary. The refrigeration necessary to maintain a given temperature for groups of 100 and 1,000 persons respectively has been worked out by Gordon M. Fair, instructor of Sanitary Engineering.[1]

Men prefer the temperature of drinking water at about 46 degrees Fahrenheit in summer and from 50 to 52 degrees in winter. To be entirely palatable it should not vary more than a few degrees from 50. Consumption may be based on the following tabulation:

TABLE 92

AMOUNT OF DRINKING WATER REQUIRED IN 24 HOURS:[2]

Particulars	Quarts of Water		
Workers at rest	2	4	2
Ordinary conditions	3	6	3
Hard work	5	10	4
When the conditions are:			
Temperature	Ordinary	High	Low
Humidity	Ordinary	Low	High

If the plant is working on a three-shift basis the above figures apply; otherwise the amounts need modification. In the Commonwealth Steel Company, of Granite City, Illinois, fresh pure water is sent out in the hottest weather at 48 degrees and returned through the circulation system at about 53 degrees. The drinking fountains are placed at intervals of 50 to 75 feet in the shop and yards. An ammonia compression refrigerator with a 20-ton capacity is used. The cooling room is thoroughly insulated by cork board and cement and is covered on the inside and bottom with white tile to form a storage reservoir for the cooled water.[1]

---

[1] Fair, Gordon M. "The Sanitation of Industrial Water Supplies," *Journal of Industrial Hygiene*, 1920, p. 457.

[2] Watkins, J. A. "Drinking Water in Industrial Plants," *Safety Engineering*, February, 1920.

When it is known that employees are accustomed to take three or four drinks per day on company time, and further that abundance of fresh water is important in the maintenance of health, it seems desirable that each employer should consider the subject as one worthy of constant attention.

---

[1] Wallis, George Earl. "Have You a Good Drink of Water in Your Plant?" *National Safety News*, May, 1922, p. 27.

XXVII

CONCLUSION

Health improvement practicable. An aid to production and a symbol of good-will. The plant as a health unit. Prevention versus cure. Plant medical work inexpensive. A part of the organization Its present position. Medicine and surgery contrasted. Common ailments important; occupational diseases infrequent. Health maintenance, the remedy. State health insurance, the alternative.

SUFFICIENT evidence, it is submitted, has been advanced to prove that industry has special health hazards of its own from which those outside industry are entirely free, and, also, that the workshop accentuates some of the commoner complaints to which every one is exposed. In addition, an attempt has been made to show that the status of industrial health is capable of improvement without any radical change or costly effort on the part of the employer. Moreover, the time is ripe for such an effort.

Organized labor has failed to solve the health problem of its members, merely concentrating its forces, with one exception, on the payment of sick benefits. It has been forced, by the nature of the circumstances under which it operates, to neglect the gospel of prevention. Unorganized labor is no better off except in so far as the members of mutual aid associations are in alliance with the medical department in some plants.

From the employer's point of view, labor is scarce and likely to remain so owing to what now appears to be a fixed national policy—that of restricted immigration. This situation throws the employer back on his own resources—the employees in his plant. If he cannot add to his labor force at will, as hitherto, he can at least try and secure more production from those within his reach, and while the possibility of increased production from improved machinery is by no means exhausted, no great returns can be expected from this source. Health maintenance in industry is as yet largely an unmined field the possibilities of which have scarcely been realized. It is not alone useful because it is a real aid to production; it is also a symbol of good-will and tends to smooth out one of the underlying causes of friction. Medical attention helps the worker by relieving pain and suffering; it lessens the economic burden of medical costs when no wages are coming in, and, whether the worker admits it or not, a good medical service stands as a bulwark against the fear of sickness which is always present among those workers who have saved little or who have earned too little to save.

The foregoing pages aim to show, among other things, that the industrial plant, as a unit, lends itself peculiarly aptly to the practice of preventive medicine. The value of preventive, as distinguished from curative, medicine in industry can hardly be emphasized sufficiently. Ordinary medical work, in the nature of things, has to concentrate on curative processes in family practice merely because the preventive function cannot be exercised when people neglect seeing a doctor until they are too sick to move. On the other hand, prevention is the main feature of industrial medical service.

By what may be called wholesale health conservation the employer is enabled to provide his employees with good medical service at low cost; the group is more or less homogeneous, works under like conditions, is concentrated within a small area, and amenable to certain influences which are wholly inoperable under community conditions. Employees will all attend a lecture on health education on company time, for instance, but they will not voluntarily do so after work. Industrial medicine has some disadvantages. Some workers object to it and it has been alleged that it is capable of abuse. This need not be denied; even the devil can quote scripture for his purpose, but the fact remains that few employers have ever aimed to use industrial medicine as an instrument of oppression or a vehicle for paternalism, and the fear of such contingencies on the part of the worker is generally quite remote. The advantages, however, far outweigh its possible disadvantages. A fair reading of the evidence leads to the conclusion that, if health conservation must be considered on a cash basis, it pays. But the return chiefly derived from making the working force healthier can hardly be estimated on a cash basis and, consequently, no accurate appraisal is possible.

In the case of accident prevention, for instance, concrete returns are shown in the saving of time lost due to accidents. This gain is only remotely indicative of the amount of bodily suffering avoided by the worker. Freedom from pain superinduces good-will just as the infliction of pain engenders ill-will. When, in such instances, the question of strike is being discussed among workers it is conceivable that the balance may be turned one way or the other by those who have suffered or those who have been saved from suffering in the plant.

There is no longer any mystery about the mechanisms of health conservation in industry. Plant medical work has gone beyond the purely experimental stage and enough is now known to indicate what should be done as well as what should be avoided. No employer should, from mere impulse, attempt to impose medical service on unwilling employees; rather should he proceed from his intelligence, having ascertained their desires. Modern ideas in labor management are coming to accept the practice of consulting employees in matters that affect them directly and in no situation is this practice more desirable than in health conservation.

All employees would be the better for skilled medical attention, but not all plants have the same character of medical problem. When the special medical needs of a plant have been ascertained the medical department should be definitely installed as part of the plant organization and should not be left to shift for itself as a sort of an extraterritorial activity. Its success depends on a solution of the human as well as the mechanical difficulties which may be encountered. The careful selection of the doctor is important, but so, too, is the creation of the feeling among the workers that the employer is truly and unreservedly interested in keeping the workers healthy for their sakes as much as for his, and this cannot be done in a hurry.

On the whole the introduction and successful operation of medical, hygienic, and sanitation work is no more difficult than the creation of any other new development, such as the establishment of an engineering or research department, but it is a mistake not to apply the same principles in one case as in the other.

One of the extraordinary facts about health conservation in industry is its unequal development. Some few employers, here and there, have developed the subject highly while others have not as yet benefited, nor attempted to benefit, by these experiences. Certain industries, such as pottery, are still in a primitive condition as regards the maintenance of health; such industries learn nothing and forget nothing, and the products of their rivals from other countries would displace their wares were it not for the accident of remoteness which prevents competition.

Dr. C. D. Selby made an important statement before the Fifty-third Annual Meeting of the American Public Health Association at Detroit, October, 1924. After an extensive investigation he found that not 1% of all American plants appear to have (in 1924) adequate medical service, although emergencies are fairly well provided for. Caring for emergencies, however important, is only part of an extensive field, as indicated by the wide variety of subjects discussed in the preceding pages. Emergency work, however, is an excellent basis upon which to build a broader service, and the transition may easily be accomplished. The staff and equipment are already there and the benefits derived from emergency work have already become apparent. It is but a short step to include the more obvious medical needs.

The practice of medicine and that of surgery differ in several respects. Accident cases occur "suddenly and violently," their cause is obvious and correctable; the results are plain and cases are easily treated; the time of onset and cure are usually definite and there is no preceding period of disability. Sickness, on the other hand, comes on gradually and imperceptibly and a man's productive capacity may be lowered considerably before actual treatment begins; the cause of sickness is often obscure, it may be contagious in character, and the remedy is not always apparent, since there may be a wide variety of contributory causes. Finally, prevention and cure are separate functions in accidents and undivided functions in medical work.

Industrial medical service is essentially a matter of attention to a number of seemingly trivial details from which results are neither apparent nor immediate, though nevertheless important. Health is undermined slowly; the process of building up health in the working force is no less slow. No magical results can be expected and any one who sets out with a different idea is doomed to disappointment.

If, as Dr. Selby states, adequate medical service is provided in less than 1% of the plants of the country, it is full time that employers should widen the scope of their emergency service to include medical treatment. That is actually what has occurred in most of the well-developed plants, and the experience may be followed with entire safety. It is inadvisable to follow the not unusual practice of attempting to acquire information by means of the questionnaire which is too often a means used by those who know little to acquire knowledge from those who know less. The questionnaire can only be used effectively by those who know their subject thoroughly in addition to the background upon which the enquiry is based.

Medical is far more important than surgical service when considered from the standpoint of health maintenance, as has been clearly shown in the text. It is not the accidents that cause the greatest loss of productive working time, nor indeed, is it the rare or spectacular occupational diseases. The ordinary maladies, the common cold, and other pulmonary troubles, nervousness and rheumatism result in a vastly greater loss of time and they should receive major attention, since they constitute the real difficulty in maintaining a healthy and efficient force.

Anthrax, mercury, and arsenic poisons are really very rare and may be entirely disregarded by the plant physician in the vast majority of industrial concerns. For instance, only about six states report the occurrence of industrial anthrax. In plants where such occupational hazards may occur the subject should, of course, be given the utmost attention. Many complaints have been made about the failure either to recognize or to study occupational disease. In a report of the Committee on Industrial Hygiene, read before the Conference of State and Provincial Health Authorities of North America, at Lansing, Michigan, on June 7, 1924, it was stated that, "We believe that with the exception of half a dozen places little is actually being done to secure data regarding occupational diseases." Such maladies cannot be eradicated or cured by ignoring them. It is not unlikely that a great deal more of occupational disease occurs than is reported even in places where reporting is mandatory. It is discouraging to realize how few employers acknowledge, even to themselves, the possibility of occupational diseases and this attitude is sometimes shared by the industrial doctor. The real source of information as to the existence of occupational poisons may readily be found by a comparison of plant purchases with lists of occupational poisons, yet this obvious source of information is often neglected.

Medicine in industry offers no abstruse problems apart from the eradication of occupational diseases which, with the exception of lead, are concentrated in quite a narrow range of industries. It is fundamental, however, that any employer, interested in the maintenance of health, should know accurately the nature and extent of the health problem in his own plant first. It is for lack of such knowledge that there is failure either to begin or to proceed intelligently after a beginning has been made. Periodic health inventories might be of considerable service to an employer where there is no regular medical service. They might explain, even if they would not remove, occasional drops in production due to a large number of minor ailments the prevalence of which would be otherwise unsuspected. Periodical studies of the sort prepare the way for the introduction of medical service, but even without them an increasing percentage of absences is indicative of sickness since the latter is the largest single cause of absence.

If the employers do not tackle the health problem in industry more energetically than hitherto the state will step in and impose a long-threatened system of Industrial Health Insurance. Any attempt to do this will be disastrous and useless, according to some honest and well-meaning employers; others, for purely selfish reasons, oppose the idea with unreasoning prejudice. But there would be little occasion for fear of State Health Insurance if employers merely expanded their emergency surgical services to include medical treatment. No state has as yet adopted health insurance, but some one may be forced to action by the pressure of public opinion. The high death-rate among industrial workers is a matter of common knowledge, and persons of sociological leanings believe that the only remedy is health insurance. There are several objections to State Health Insurance; in essence it is curative and not preventive, but the penalized employer is forced in self-defence to adopt the principle of prevention.

The issue of State Health Insurance is not, at the moment, acute. Bills have been introduced into various legislatures without success. When such a bill is passed, one state after another will follow suit as in the case of the Workmen's Compensation Acts which have spread over the country in little more than a decade. The situation is an obvious challenge to the industrial world and upon its frank acceptance depends whether the state or the employer will control the health situation in the plants of the country. The wide-spread adoption of health maintenance, carried out in a full and generous spirit, would make State Health Insurance unnecessary and would quite probably bring an immeasurably greater return than any expenditure involved, as in the case of workmen's compensation.

INDEX

INDEX

A

- Abdominal inspection 222
- Absentism
  - cost of sickness causing 46
  - extent of 29, 31
  - in National Cash Register Company 45
- Accidents 279
  - and sickness, compared 31, 127
  - cause of 281
    - carelessness 288
    - language 283
    - length of employment 283
    - machinery 288
    - mental attitude 296
  - compensable 155
  - cost 36, 320
  - fatal 282
  - industrial 280, 307
    - automotive 280, 307
    - metal 280, 307
    - paper and pulp 280
    - petroleum 280
    - rubber 280
    - woodworking 280
  - inspection 295
  - methods 290
  - prevention 287
    - education 290, 299
    - engineering revision 293
    - machine guards 290
    - organization 290
  - prevention and relief compared 320
  - records 303-304
  - reduction 307, 316
  - statistics
    - by industry 280, 307
    - fatal 281, 282
    - non-fatal 281, 282
  - time of occurrence 284
- Agricultural labor, mortality of 21
- Air
  - ducts 344
  - impurities 328, 339
  - supply 326, 334
  - *see also* Ventilation
- American Association of Industrial Physicians and Surgeons 63, 77
- American Cast Iron Pipe Company 249
- American Engineering Standards Committee 294, 360
  - sanitary standards of 419
- American Management Association 277
- American Mutual Liability Insurance Company 314
- American Posture League 404
  - chair recommended by 409
- American Public Health Association 473
- American Pulley Company 255
- American Rolling Mill Company
  - accident experience 310
  - emergency hospital plan 96
  - medical advice 51
  - medical department 97
- American Smelting and Refining Co. 308
- American Social Hygiene Association 148
- American Society of Heating and Ventilating Engineers 324, 331
- Animal dust
  - *see* Dust
- Anthrax 202
- Applicants
  - hernia in 211
  - physical examination of 211, 226
  - rejection of 226, 227
- Arsenic 158-159
- Artificial lighting
  - *see* Lighting
- Association for Labor Legislation 37
- Atcheson Harden Company 366
- Attendance at hospital 67
- Auditorium 372
- Austin Company 379
- Automotive industry accidents 280

B

- Baths 445
- Benjamin Electric Company 377, 378
- Benzol poisoning 184
- Bethlehem Steel Corporation 442
- Blast furnace accidents 286
- Bubblers 432, 467
  - apportionment of 467
  - types of 467
- Budd, Edward G. Company, food supply 370
- Bulletin-boards 302
- Burroughs Adding Machine Company 451

- Cadbury Brothers, Ltd , death-rate 45
- Cafeteria 367
  - cost compared with lunch rooms 376
  - popularity of 371, 372
  - staff of 378
  - *see also* Lunch rooms
- Cambria Steel Company, infections in 272
- Canadian Committee on Industrial Fatigue 391
- Carbon monoxide 177
  - occurrence of 159, 177
  - resuscitation in 186-189
  - symptoms of 159
- Carelessness causing accidents 287
- Carnegie Steel Company 272
- Case, J. I. Threshing Machine Company 262
- Ceiling hooks 458
- Census of Manufactures, 1923 29
- Chairs 404, 405
  - *see also* Seating
- Chaney, Dr. Lucien 293
- Cheney Brothers
  - sickness cost 46
  - self-insurance 316
- Cheney, Howell 37, 46
- Chest examination 222
- Chlorine gas as a cure for colds 131

Cincinnati Milling Machine Company
  lunch-room management 377
Clark, Dr. W. I. 229, 230, 277
Classification
  health hazards 35
  injuries 286
  occupational diseases 152
Cleaning, plant 462
  refuse cans in 464
  rotary brushes in 463
  vacuum cleaning 463
Cleanliness, personal 175
Clinic
  see Surgery; First-aid
Clothing 205
  laundry of 460
Cobb, Dr. Stanley 121
Codes 294
  lighting 361
  morbidity 93
  mortality 93
  safety 294
  sanitation 419
Colcord, Dr. C. A. 63, 217-218
Colds, common 227
  extent 228, 230
  treatment 130-131
Collins Manufacturing Company 401
Colorado Fuel and Iron Company
  medical advice for staff 51
  medical facilities 98
Commonwealth Edison Company 378
Commonwealth Steel Company, water supply 468
Compensable accidents 155
Compensation, or prevention of accidents 320
Compressed air, hours of work in 398
Conference Board of Physicians in Industry
  definition of physician 62
  first-aid standards 267
  hernia 236
  physical examination 220
Constipation, occurrence of 135
Continental Motors Corporation 97-98
Contract system of medical service 59
Cooperation with community in health maintenance 69
Coordination of medical work 56
  with employment 57, 76
  with outside agencies 77
  with production departments 56
Cost of medical department 274-278
  of sickness 35
Cotterell process in air purification 173
Counter-shock in resuscitation 188
Crane Company dental department 253
Crocker McElwain Company 210
Crompton & Knowles, baths for workers 448
Cutler Hammer Company, visiting nurses 51

Dangerous trades 17
Dearden, Dr. W. F. 22
Death-rate
  see Mortality
De Blois, L. A. 182
Defects
  see Physical impairments
De Hart, Dr. Sanford 376
Dental department organization 250
Dentistry 244
  cost of 252
  in Pennsylvania plants 245
  scope of 246
Dersheimer, Dr. F. 124
Disabilities, physical 27, 208
  permanent 285
Diseases
  classification 93
  compensable 318
  occupational 150
    cause of 156
    classification 152
    extent 151, 152
    investigation of 475
  respiratory 130, 227
  skin 198
  venereal 145
  see also Sickness
Dispensary 83, 104
  equipment 106
  handling of workers in 129
Disston, Henry & Son, accidents in 308
Doctor 62
  capability of 69
  conditions of employment 67
  definition of 62
  part-time 59
  qualifications of 64
  salary of 68
  selection of 63
  whole-time 58
  woman 60
Downey, E H 314-315
Dressing booth for physical examination 220
Dressing unit, surgical 264
Drinking fountains
  see Bubblers
Drinking water 465
  filtration 465
  refrigeration of 467
  supply 465, 466
Du Pont de Nemours Company 148
  emergency showers 446
  nitrous oxide poisoning 182
Dust 35, 190
  animal 191
  classification of 191
  inorganic 191
  metallic 191
  mineral 191
  occupational 152-153
  organic 191
  prevention of 196
  vegetable 191
Dyes 201

Eastman Kodak Company 215
  examination of executives 215
  lunch rooms 378
  self-insurance 316
  temperature control of process 332
Eaton, Crane & Pike Company 214
Edison Company medical department 94
Edison Electric Illuminating Company 31
Education
  safety education 284, 290, 298
  see also Health education
Emergency hospital 80
  construction 84
  equipment 89

  laboratory 89
  location of 82
  plans of 81, 96
  rooms of 80-81
  scope of 80
  size of 81-82
Employee's handbook 299
Endicott-Johnson Company
  cost of medical service 275
  family medical service 50
  medical department 98
  self-insurance 316
Engineering revision in accidents 293
Epidemics 131
  prevention of 134
Equipment
  dental 251
  dispensary 106
  lunch room 375
  physical examination room 234
  surgical 87, 265
  wash-room 439
Evaporation and temperature 337
Exhaust systems 345
Eyes 238
  defects in industry 238
  examination of 239
  strain a cause of fatigue 391
  testing of 241
Eyesight Conservation Council 238

F

Fair, Gordon M. 468
Family medical service 50
Fans 342
Fatal accidents 261
Fatigue 384
  cost of 384
  definition of 385-386
  factors in 387
  removal 394
  seating to relieve 404
  speed as a factor in 389
Females
  see Women
First-aid 83
  equipment 87, 265
  kits 263
  organization 262
  room 83, 263
  surgical 260
  standardization 267
  training 273
First-aider 269
Fisher, Boyd 296
Fisher, Captain R. G. 269
Fisk, Dr. Eugene L. 44
Fitch, Mr. W. N. 419
Floors
  hospital 84
  lunch room 372
  toilet-room 434
Food supply 367
  and fatigue 394
  methods of 372
Ford Motor Company and eye examinations 240
  factors in safety work 310
Forms
  accident report 303
  dental 254
  medical 91
  nurse's 73

  physical examination 220, 224
  sanitation 416-417, 422
Frequency rate of accidents 280, 305
Fulton Bag and Cotton Mills 51

Gases 153
  carbon monoxide 159, 177-178
  classification of 153
  nitrous oxide 181-182
Geier, Dr. Otto 44
General Electric Company
  cafeteria 379
  lunch room 376, 379
    payment in 381
General Optical Company, eye examination 239
Gilbert & Barker Manufacturing Company 301
Gilbreth, Frank, and fatigue losses 384
Goodrich, B. F Company 51
  sanitary standards of 419
  wash troughs 441
Goodyear Tire and Rubber Company
  factory window space 342
  lunch rooms 367
  water purification 466
Gompers, Samuel, and medical work 13
Government Printing Office, lunches 381
Greenburg, Leonard 344, 350
Greenfield Tap and Die Corporation
  laundry 461
  physical examination 214
  temperature control 337

H

Hagerstown sickness survey 141
Hamilton, Dr. Alice 173, 175
  benzol poison 185
  carbon monoxide 178
  nitrous oxide poison 182
Hand drying 442
Harvard University School of Public Health 63, 325
Hayhurst, Dr. Emery R. 335, 390
Hazardous occupations 17
Headaches in industry 135-136
Health
  education 49, 108, 109, 110
    literature 148
    methods 111
  hazards 33
  hints 113
  importance of 4, 7, 11
  improvement 44
Heart disease 137
Heat 360
  effect on production 351
  of human body 351
  reduction 352
Heating plant 350
  in factories 354
  in foundries 354
  indirect 335
  systems 355
Hercules Powder Company 148
Heinz Company, dental work 253
Hernia 211, 229
Hood Rubber Company
  accident disabilities 316
  eye examination 239
Hookstadt, Carl 279-280

Hopkins, Dr. E. M. 126
Hospital
  see Emergency hospital
Hospital attendance 58
Humidity 327, 332
  and temperature 336
  control of 335
Huyck, F. C., medical work 276
Hygiene, university course in 63
Hygrometer, in temperature control 335

I

Ideal work curve 386
Illinois Malleable Steel Company 325
Illinois Steel Company 290
Illumination
  see Lighting
Industrial Accident boards and commissions 314
Industrial Fatigue Research Board
  efficiency studies 332
  fatigue research 392
  lighting and production 364
  rest pause study 399
  ventilation studies 348
Industrial hygiene
  see under specific heading
Industrial physician
  see Doctor
Industrial Relations Commission 30
Industrial Welfare Society 36
Industry and health 15
Infections 270
  cause of 271
  extent of 271
  in Pennsylvania 273
  location of 271
  prevention of 272-273
  reduction of, due to medical work 272
Influenza 131
Injuries, industrial
  and length of employment 283
  classification of 286
  extent of 260
  location of 285
  nature of 262
  tabulation of 304
Inorganic dust 191
Inspection
  accident 295
  lighting 364
  sanitary 417
Insurance, accident
  cost of 314, 316
  methods of 313, 317
  reduction in 309, 316
Insurance, State Health 8, 12
International Harvester Company
  medical advice for staff 51
  medical department 97
International Ladies Garment Workers' Union 210
Iodine in wound treatment 269
Iron and steel industry accidents 286, 307

Jacobsohn, Dr. William 204
Jarret, Mary C. 123
Jeffrey Manufacturing Company 376
Joint Board of Sanitary Control 13, 406
Joliet Steel, plant lunch room 373
Joseph & Feiss Company 253, 396
Jury, accident 297

K

Kata-thermometer 337
Keith, George E. Company, health hints 142
Kelly Springfield Company 148
Keystone Steel and Wire Company 379

L

Labor Laws 39
  drinking water 466
  health 39, 40
  humidity 333
  industrial poisons 159
  lighting 358
  locker-rooms 454
  seating 405
  showers 446
  towels 443
  ventilation 326
Lamps, care of 364
Lauffer, Dr. C. A. 234-235
Laundry, plant 460
Laws
  see Labor laws
Lead poison 159, 163
  extent 151, 164
  prevention of 170
  symptoms of 168
Le Blond Machine Tool Company
  use of lunch rooms 372
  hospital 95
Length of employment and accidents 283
Liberty Mutual Insurance Company 91
Life Extension Institute
  physical examination results 44, 208
  rules of hygiene 114
  syphilis in industry 146
Lighting 358
  artificial 362
  code 360
  cost of 365
  essentials of good 359
  in hospital 85
  measurement 363
  natural 360
Literature, health 112-113, 148
Location of injuries 285
Lockers 453
  assignment 454
  size of 432, 455
  specifications for 455
  types of 432, 453
Locker-room 432
  location of 422, 453
  purpose of 453
  ventilation of 454, 457
Longevity of industrial workers 20
Luckeish, M. 360
Lunch rooms 367
  attendance at 370, 373
  cost of 382
  equipment of 375
  factors in starting a 370
  floors 372
  management of 377
  payment for meals in 368
  plan of 373
  seating capacity of 375
  size of 374
  survey of 373
  waiting in 378
Lunch wagon, use of 371

M

McCord, Dr. Carey 44
Medical care 50, 74, 94, 103
  in plants 94, 103
  of employees 51
  of families of employees 50, 74
Medical cost 274, 278
Medical department 103
  duties 91
    administration 91
    health education 108
    physical examination 206
    treatment of disease 127
  organization 58
  Practices Act 72
  records 69
  service 41
    extent 42, 473
    functions 54
    for families of employees 50
    growth 41
    installation of 52
    of insurance companies 59
    part-time 59
    purpose 6, 48
  staff 62
    assistant 75
    clerks 75
    doctor 62
    nurse 70
  survey 144
  treatment 68
    colds 130
    epidemics 133
    respiratory diseases 141
    venereal diseases 145
Menstruation 136
Mental defects of workers 119
Mental hygiene 116
Mental industry accidents 280
Metallic dusts
  see Dust
Metallic poisons 152
Methyl alcohol 160
Mercurial poisoning 160
Metropolitan Life Insurance Company 15, 16
  dental equipment 251
  heating 354
  lunch rooms 376, 381
  physical defects of employees 28
  towel cost 444
  ventilation 324
Mineral dust
  see Dust
Minor ailments 135
Mock, Dr. Harry E. 227
Montgomery Ward Company 255
Monthly Labor Review 279
Morbidity
  see Sickness
Morey, Arthur T. 310
Mortality 15
  age in relation to 16, 20, 22
  cause of 18, 19
  dangerous trades 17
  female 16, 19
  industrial 17, 19
  lead poisoning as a cause of 164
  male 16, 19
  occupational 21
  poisons 152
  wage-earners 16
Mutual insurance 313

N

National Affiliated Organizations 266
National Cash Register Company
  absentism in 45
  dental work of 249, 253
  medical service of 95
  physical examination in 212
  safety work of 299
National Committee for Prevention of Blindness 238
National Consumers League 407
National Electric Lamp Works 252, 376
National Electric Light Association 288
National Health Council 211
National Industrial Conference Board
  fatigue survey 397
  physical examination 211
  rest periods 401
National Malleable Castings Company 308
National Safety Council
  accident statistics 280
  benzol poisoning report of 186
  codes for safety of 294
  Safe Practices pamphlets 294
  safety education 284
  safety literature 298, 302
  sanitation 419
National Safety News 310
Natural lighting
  see Lighting
Negligence as a cause of accidents 287
New Jersey Manufacturers Casualty Company 314
New York City Health Department 114
New York State Department of Labor 79
New York State Industrial Commission 409
New York State Ventilation Commission 340, 348
New York Workmen's Compensation Commission 270
Nitrous oxide poison 182
Nomenclature 4, 83
Non-industrial medical work 68
Norton Company
  cost of medical service compared with cleaning cost 276
  dental work 253
  heart disease rate 137
  infection rate in 272
  medical department 94
  medical work confined to employees 51
Nurse, industrial 70
  duties 71
Nurse, visiting 51, 70
  duties 71
  report of 73

Occupational disease
  see Disease, occupational
Ocean Collier Company, showers for workers 448
Occupations
  death-rate in various 20, 21
    dusty trades 193
    of females 16, 19
    of fur cutters 174
    of lead workers 168
    of machinists 21
    of stenographers 143
    of telephone operators 143
  for cardiacs 139

Occupational dusts
  see Dusts
Occupational hazards 158
  anthrax 202
  dusts 191
  poisons 157
Ohio Industrial Commission 283
Ohio, occupational diseases in 153
Oliver, Sir Thomas 140
Operating room 88
Organic dusts
  see Dust

Parker, Carleton 117
Pennsylvania State Department of Labor 271
Pennsylvania Steel Company, hospital 81
Periodical, plant 298
Perkins, H F 310
Petroleum refinery accidents 280
Phelps, Dr L A 236
Phelps Dodge Corporation 148
Physical examination 206
  advantages of 211
  and venereal disease 147
  compulsory 51, 210
  defects found in 27, 28
  equipment for 234
  growth of 41, 211
  in army 25
  length of 232
  methods in making 217
  object of 207
  of applicants 276
  of executives 51
  periodic
  place of 233
  systematization of 219
  time of 231
  types of 210
  voluntary 51, 210
Physical impairments
  character of 208
  classification of 225
Physician
  see Doctor
Pierce Arrow Motor Company 464
Plans, hospital 81, 86, 96
Plant inspection
  lighting 364
  safety 295
  sanitary 417
Plumbing, hospital 85
Plumbism
  see Lead poison
Poisons 152
  arsenic 179
  benzol 184
  lead 151
  list of 157
  mercury 173
  multiple 175
  nitrous oxide 181
Pool, C. L. 402
Posture 404
  faulty 408
  improvement in 408
Practicostatum 329
Pratt, Dr G K. 120
Prevention, accident 287
Prevention, sickness 48, 104
  lead poison 170
  methods 108
  of epidemics 133
Production in relation to heat 351
  hours of work 392
  lighting 365
  rest periods 402
  seating 404
  temperature 329
  ventilation 325
Prone pressure resuscitation 187
Protection from poison 162
Prudential Insurance Company 140
Psychiatry 116
Psychoneurosis 120
Psychiometer 335
Public health 38, 39
Pulp and paper mill accidents 280

Qualifications
  doctor 64
  first-aider
  nurse 70
Quinby, Dr. R. S. 316

Radio in health education 112
Railroad employees, venereal disease 146
Rand, Dr W H. 176
Records, medical 91
Refrigeration of drinking water 467
Rejection of applicants 225
  cause of 226, 228
  classification of 225
  extent of 226
Respiratory diseases 128, 227, 349
Responsibility
  for accidents 287
  for health workers 37
  for medical service 55
Rest periods 395
  and rest-rooms 403
  objections to 402
  survey 396
  to increase production 402
Rest room 403
Resuscitation 186
Retail Credit Company, and influenza 134
Robert Gair Company's eye examination 239
Rotary brush for cleaning 463
Rubber industry accident record 280

Safe practices 294, 309
Safety 279
  campaign 301
  Code Correlating Committee 294
  codes 294
  committees 291
  contests 307
  engineer 291, 295
  literature 298
  organization 288, 290
  standards 294
  talks 303
Salamanders, dangers of 356
Salary of physician 278
Sanitarium 144
Sanitary department 415
  functions of 418, 419
  inspection by 421
  organization of 416

Sanitary standards 419, 422
Sanitary unit 423
Sanitation 415
Sappington, Dr. C. O. 31
Sawyer, Dr. W A. 215
Schafer method of resuscitation 187
Scott, Walter Dill 213
Scovill Manufacturing Company 292
Seating 403
  in New York industries 407
  in Pennsylvania plants 408
  methods of 408
  types of chairs 404, 409
Sefton Manufacturing Company, rest periods 400
Selby, Dr C B 473
Self-insurance in accidents 313, 316
Severity rate of accidents 280, 307
Shattuck, S. F 310
Sherman, Dr W. O'Neill 272
Shower-baths 445
  compartments 429
  emergency 446
  state requirements 446
  survey 446
  types of 446
  usage 448
Sick benefits 12
Sickness 22
  and absence 29
  and accidents compared 31, 127
  and labor legislation 39
  cause 32, 34
    in Edison Company, Boston 128
  cost 35, 274
    Cheney Brothers 46
    Endicott-Johnson Company 275
    Retail Credit Company 134
  extent 24
    compared with accidents 31, 127
    in community 24
    in Edison Company, Boston 128
    in Metropolitan Life Insurance Company 28
  female 109, 136
  losses due to 43, 127
  of male whites 28
  preventability 43
  prevention 49
  records 92
  reduction of 58
  responsibility for 37
  survey 23, 47
    in army 25, 26
    in England 27
    in Hagerstown, Maryland 24
    in industry 28
  treatment of 103
Skin disease 198
Slogans, safety 301
Soap 433, 444
South London Metropolitan Gas Company 297
Speed and fatigue 389
Sperry Gyroscope Company
  accident time lost 309
  self-insurance 316
Standard Oil Company
  accidents 308
  sanitary standards 419
Standards, safety 294
Standards, sanitation 419, 422
Standards, ventilation 346
State accident insurance 313
State health insurance 8, 476
State laws
  see Labor laws
Statistics
  accident 286, 307
  applicants 211, 226
  attendance at hospital 58
  disability 27, 208
  infection 271
  lunch-room attendance 370
  medical 91, 98
  mortality 15, 32
  physical examination 206
  poisons 152
  rejection of applicants 225
  sickness 128, 227
  sickness survey 141
Stenographers, sickness rate of 143
Stetson, J B. Company 253, 368
Studebaker Corporation 342
Supplies, cost of medical 275
Surgery 259
  construction of 84
  equipment of 87, 265
  first-aid 83, 262
  furniture of 90
  layout of 86
  scope of industrial 48, 260
Surgical department 259
  cost of 274
  instruments for 90, 265
  standardization in 267
  supplies 90
  treatment 268
  unit 87, 264
Swimming pool 448
  indoor 451
  plan of 450
  usage of 451
Syphilis
  see Venereal disease

Teagle, Walter, on safety essentials 310
Teeth
  see Dentistry
Telephone girls, sickness rate of 143
Temperature 327, 336
  and humidity 333
  and output 329, 334
  in toilet-rooms 435
  in workrooms 330
Temperature, humidity and air motion 337
Tennessee Coal and Iron Company 449
Thermometer, in temperature control 331
  kata-thermometer 337
Thermostat 355
Time lost
  from absence 45
  from accidents 127, 306
  from sickness 30, 127, 228
Toilet facilities 415
  apportionment 436
  standards 426
  urinals 428
  water-closets 426, 437
Toilet-room 434
  cleaning of 435
  floors 424, 434
  heating of 435
  location of 434
  standards 422
  ventilation of 424, 435

  walls 424
  windows 424
Towels 433, 443
Trade risk in accidents 287
Trade unions and physical examination 213
Traumatic hernia 234
Tuberculosis 19, 140, 194

U

Underwood Typewriter Company 239
United Shoe Machinery Company 356
United States Bureau of Mines 178
United States Pension Board 348
United States Public Health Service
  health education 48
  pottery industry survey 173
  sanitary standards 419
  sickness records of 91
  ventilation investigation of 337, 350
United States Steel Corporation
  accident cost 320
  accident reduction 308
  lunch rooms 374
  sanitary standards 419
  shower-baths 446
Unrest and sickness 10
Urinals 426-428, 438

Vacuum cleaners 463
Vegetable dusts
  see Dust
Venereal disease 145
Ventilation 323
  and air movement 327, 339
  and disease 349
  and humidity 327, 332
  and output 325, 332
  and respiratory diseases 349
  and temperature 327, 330
  artificial 335
  elements in 327, 339
  in foundries 324
  in offices 323
  laws relating to 326
  methods of 324
    mechanical 342
    structural 341
  natural 342, 349
  nature of 328
  of toilet-rooms 424, 433
  standards 345
Vision
  see Eyes

W

Waiting period in accident insurance 319
Waiting-room hospital 87
Wahl Eversharp Company 276, 371
Walls, hospital 85
Wanamaker, John 255
Warren, Dr. B. S. 30
Wash-basins 440
  apportionment of 430, 440
  state laws as to 441
  statistics 440
  types of 441
Washing facilities 439
  bowls 440
  circular fountain 442
  time allowed for use of 442
  troughs 442
Wash-room 439
  advantages of 439
  equipment of 440
  standards 422, 428
  survey of 439
  towels 442
Water 465
  cooling 468
  purification 449
  supply 430, 431
  swimming pool 449
Water-closets 425, 437
  apportionment 427, 436
  compartment 425, 437
  types of 437
Welfare work, early instance of 4
Western Electric Company
  lunch room 370
  plant hospital 95
  temperature control 332
Westinghouse Electric and Manufacturing Company 148, 381
White Motor Company, lunch rooms 381
Whittaker-Glessner Company 377
Willys-Overland Company 371
Winchester Repeating Arms Company
  infection rate 272
  medical service 71, 97
Windows
  factory 342, 360
  in ventilation 342, 349
  toilet-room 424, 433
Winslow, C E A 325, 344
Wisconsin Industrial Commission 286
Wisconsin Steel Company 377
Women
  mortality of 16, 19
  occupations of 139
  rest-rooms for 403
  seating of 404
  sickness of 109, 136
Woodworking industry accidents 280
Worcester County Safety Council 308
Work hours and fatigue 392
Workers and accidents 287
Workers' Health Bureau 13
Workmen's compensation 312
  and occupational disease 54
  and physical examination 206
  and prevention of accidents 320
  cost of 312
  insurance methods 313
  rate of compensation 319
  reduction of insurance rate 314
  self-insurance in 315
  types of 318

X-ray

Yagloglou, C. P. 327-328, 331
Young, R. J. 290
Youngstown Sheet and Tube Company 419
Youngstown Wire and Iron Company 458

Z

Zinsser, Dr. H.

STATE CENTRAL LIBRARY W.B. ★ VIP Road Kolkata ★